

Aviation Week

and Space Technology

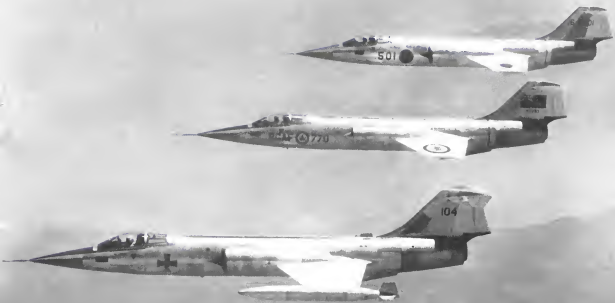
December 18, 1961

**USAF Requests
Manned Lunar
Rover Studies**

75 Cents

A McGraw-Hill Publication

Lockheed F-104s for Allies



materials / 61



HANDBOOK OF FASTENER TECHNOLOGY



STRENGTH OF MATERIALS

HIGH TENSILE NUTS

VMS-31148

High-Temperature Bolts

METALLURGY

Volumes of Performance from Voi-Shan

Voi-Shan is noted for its ability to manufacture high performance bolts, nuts and other precision fastening devices for the aircraft/military industry. It is this nation's premier in Titanium bolt manufacturing and has worked with such exotic materials as Beryllium, Zirconium, and Calsium. Other exotic materials such as Tantalum and Tungsten are consistently being experimented with for their potential use as high performance fasteners.

The bolts shown, are representative of Voi-Shan's range of experience in the manufacture of high strengths and high temperature bolts. Write for descriptive literature on these and other Voi-Shan quality products.

Material	Room Temperature Tensile Strength (Typical)	Typical Temperature Range	Typical Head Configurations
Al-4 1/2% Ti Alloy Steel	115,000 psi	-425 to 2500°F	100° Flat Head, Internal or External Hex or Spherical
A 286 Corrosion Resistant Steel Inconel X	165,000 psi	-425 to 2300°F	12 point Wrenching
M 252	175,000 psi	-425 to 1400°F	Threads, MIL S-7742 (Class 2A)
Alloy Steel (Steel 4)	180,000 psi	-300 to 580°F	
6061 Al	180,000 psi	-425 to 1650°F	100° Flat Head, Internal or External Hex or External 12 point Wrenching
Wasp alloy 500	180,000 psi	-425 to 1450°F	
A 286 Corrosion Resistant Steel	200,000 psi	-425 to 1200°F	Threads, MIL S-7742 MIL S-6679 (Class 2A)
Pt 15.7 Wt % Ir	220,000 psi	-300 to 1000°F	
Pt 15.7 Wt % Ir	220,000 psi	-100 to 1650°F	
Wasp alloy 500	220,000 psi	-100 to 1000°F	Internal or External Hex or External 12 point Wrenching
8% Chromium Die Steels	200,000 psi	-100 to 900°F	Threads, MIL S-6679 (Class 2A)

VOI-SHAN MANUFACTURING COMPANY

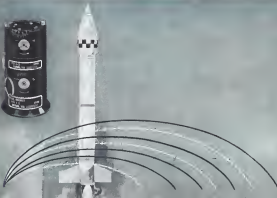
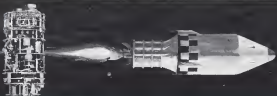
A Division of Voi-Shan Industrial Inc. for 8440 INDIANA STREET, SILVER CITY, CALIFORNIA

PROVEN IN FLIGHT...Fairechild Programmers, Fuzes, Safety and Arming Devices

Ordinance products furnished by the Defense Products Division are answering our nation's urgent need for reliable, sophisticated systems and components. Integral programming, missile fuzing, safety and arming devices, mechanical and electronic timing systems are designed and produced for special environmental requirements to close tolerances. The rugged, time-tested, lightweight programmers are performing vital control functions in current armament projects. Fairchild fuzes, also in operational use, are precision designed for high reliability application in surface-to-surface, air-to-air and air-to-ground weapons. Safety and arming devices for long-range ballistic missiles have been successfully developed and produced in quantity. For further information on how this capability can fulfill your ordinance requirements, write the Director of Marketing, Defense Products Division.



Engineers and scientists are invited to discuss new opportunities presented by continuing growth of the Defense Products Division.





The Avnet System

created a new Concept of Readiness--5 years ago!

The data shown represent Avnet's stock of different types in 1 particular line of components for the line contained. There are over 10,000 lines. Avnet's assembly facilities enable them to supply over 10,000 different types of components in any quantity, in most categories and prototype requirements. This flexibility is what The Avnet System means by "Readiness" in 40 or under. Any order.

Is this a new state of Readiness at Avnet? Did Avnet recently reach its state? Couldn't that Readiness be at up Assembly Facilities for Ready Component Prototype Requirements?

The state of Readiness at Avnet in 5 years old, 5 years ago. Avnet's Readiness is a readiness requirement and begins working at Avnet. This readiness facility was set up to provide a stock in Readiness. Days X Readiness X Flexibility X Service-Ready. Custom X On Demand. Quality Control X Through knowledge of assembly equipment for prototype needs X 5 years experience actually doing it in Readiness. It is an old story at Avnet.

And with new day brings more and more companies who want to benefit by Avnet's unique, historic Readiness. Is your company among them?



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AVNET ELECTRONICS CORP.

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AEROSPACE CALENDAR

- Dec. 20-21-Flight East Group International Model Free-Mini-View (1)
- Jan. 8-12-1987 Automotive Engineering Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit
- Jan. 8-12-Exhibit National Symposium on Reliability and Quality Control Society (Hess Hall, Washington D. C.)
- Jan. 15-17-Symposium on Optical Character Recognition, Department of the Interior, Auditorium, Washington D. C.
- Jan. 20-24-Annual Meeting, Electronic Society of America, Marriott Motor Hotel, Dallas, Tex.
- Jan. 22-24-1987 Annual Meeting, Institute of the Aerospace Sciences, Hotel Arlington, New York, N. Y. (Hudson Hotel, New York)
- Jan. 23-24-Third Annual Solid Propellant Rocket Conference, American Rocket Society, Regis University, West, Tex.
- Jan. 24-26-Second Symposium on Thermal Physical Properties Properties, N. E. Space for Heat Transfer Design, American Society of Mechanical Engineers
- Jan. 27-28-29-Exhibition Society of Electrical Engineers, Winter Ground Meeting, Hotel Rector and Columbia, New York, N. Y.

(Continued on page 6)

AVIATION WEEK and Space Technology

December 18, 1986

Vol. 75, No. 28

The world's most widely read and authoritative source for information on the latest developments in aviation and space technology, AVIATION WEEK and Space Technology is a must-read for anyone involved in the aerospace industry. This weeklies covers a wide range of topics, from the latest in aircraft design and development to the latest in space exploration and technology. The publication is a must-read for anyone involved in the aerospace industry, whether they are a designer, engineer, or manager. The publication is a must-read for anyone involved in the aerospace industry, whether they are a designer, engineer, or manager. The publication is a must-read for anyone involved in the aerospace industry, whether they are a designer, engineer, or manager.

Subscription and circulation information is available on the inside back cover. For more information, please contact the publisher, AVIATION WEEK and Space Technology, 1000 North 17th Street, Suite 100, Fort Worth, Texas 76102. Phone: (817) 339-1000. Fax: (817) 339-1001. E-mail: avnet@avnet.com.

1931...Birth of
AGASTAT®
reliability



1961...traditional quality
in the new solid state **AGASTAT**

The AGASTAT time/delay/relay principle dates back to 1951, when the first night vision flight from New York to Chicago was preparing for take off. When runway lights failed due to old style time delay relays, accuracy lowered a new design. Thus, through a need for reliability, the electronic principle AGASTAT was born—first in a distinguished series of time/delay/relays. Solid state AGASTATs meet today's needs for reliability. Location based on engineering, research and development have produced a static timing relay with the reliability essential for critical missile and computer use. Modular construction using selected semiconductor components permits flexibility and uniformity. Rigid quality control and component matching assure reproducibility.

Solid state AGASTATs time/delay/relays are supplied in six basic types for delay on pull-in or drop-out, with fixed or adjustable timing ranges from 0.01 sec. to 10 hours. Special circuitry protects against polarity reversal, provides immunity to voltage variations and transients. Operation—25-50 vdc, 50 to 125%, load capacity up to 5 amps. Write Dept. 92-1112 for technical data or immediate engineering assistance on your special requirements.

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A-286 Stainless Steel • Monel • Aluminum

The Cherrylock® Team—The Standard Cherrylock and the Built Cherrylock—offer a blind rivet that installs and performs like a solid rivet. Cherrylock rivets will qualify where you are now using a solid rivet, offering higher joint strength with greatly increased joint reliability under critical loading conditions—fatigue, shake and some vibration.

New Cherrylock gives you a blind rivet that can be used in expensive forgings as well as for joining and attaching sheets.

For technical data on Cherrylock rivets, write Cherry Rivet Division, Townsend Company, Box 2887-C, Santa Ana, California.

Cherry Rivet Division
Santa Ana, Calif.

Townsend Company

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In Canada: Paramet & Robit Manufacturing Group, Limited, Guelph, Ontario

AEROSPACE CALENDAR

(Continued from page 5)

- Feb. 6-7—Symposium on Reliability Technology for Computing Systems, Depart. of the Interior, Washington, Washington, D. C. Sponsors: Information Systems Branch, Office of Naval Research.
- Feb. 7-8—Third Western Conference on Military Electronics, IRE, Anaheim Hotel, Los Angeles.
- Feb. 14-16—International Solid State Circuit Conference, Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.
- Feb. 22-23—Range Renaissance and Training of Aerospace Vehicles, Institute of the Aerospace Sciences, San Francisco, Calif.
- Feb. 27-Mar. 1—Third Annual Symposium on Nondestructive Testing of Aircraft and Missile Components (sponsored by Center Hotel), San Antonio, Tex. Sponsors: North Texas Institute Society for Nondestructive Testing, Southwest Research Institute.
- Feb. 27-Mar. 1—Symposium on the Application of Switching Theory to Space Technology, Palo Alto, Calif. Sponsors: Lockheed Aircraft Corp., Air Force Office of Scientific Research.
- Mar. 1-3—English Registration and Scientific Conference, Sheraton, BIL, Sheraton Hotel, Washington, D. C.
- Mar. 3-6—Second Annual Gas Turbine Conference and Products Show, American Society of Mechanical Engineers, Sheraton Hilton Hotel, Houston, Tex.
- Mar. 6-8—Lecture of the Aerospace Sciences Flight Population Meeting, Johnson, Cleveland, Ohio.
- Mar. 14-16—Electric Propulsion Conference, American Rocket Society, Hotel Chateau, Berkeley, Calif.
- Mar. 16-20—International Conference, Institute of Radio Engineers, Colorado and Whitaker Hotel, New York.
- Mar. 25-28—Third Symposium on Engineering Aspects of Magnetohydrodynamics, University of Rochester, Rochester, N. Y. Sponsors: American Institute of Electrical Engineers, Institute of the Aerospace Sciences, Institute of Radio Engineers, University of Rochester.
- Apr. 1-4—Mid-Year Conference, Aeronautics Council, Sheraton Hotel, Washington, D. C.
- Apr. 1-5—Launch Vehicle Structures and Materials Conference, American Rocket Society, Ramada Inn, Phoenix, Ariz.
- Apr. 5-6—National Aerospace Meeting (including production forum), Society of Automotive Engineers, Hotel Commodore, New York, N. Y.
- Apr. 10-11—Second Symposium on The Plasma Sheath—In Effect Upon Reentry Communications and Detection, New England Medical School, Boston, Mass. Sponsors: AF Cambridge Research Laboratories.
- Apr. 18-19—Aerodynamics Conference and Electronics Show, Institute of Radio Engineers Sheraton Hotel, Houston, Tex.
- Apr. 18-19—Second International Flight Test Information Exchange Symposium, College of Aeronautics, Cranfield, England.
- Apr. 18-19—Aerospace Systems Reliability Meeting, Institute of the Aerospace Sciences, Bell Lake City, Utah.

LOWER COST-PER-LANDING ANOTHER REASON WHY MOST JETS RELY ON BENDIX® BRAKES



One airline averaged per-landing brake costs of only 86¢/lb in 30 months with Bendix. Another line reports 85¢ cost-per-landing in 30 months. Figures like these show why many jets today rely on brakes by Bendix—the world's

most experienced brake manufacturer. These dependable units also give improved pilot control and greatly reduce turn-around time. For further detailed information, write: Bendix Products Aerospace Division, South Bend, Ind.

Bendix Products-Aerospace Division



New concepts in ducting systems reflect demands for higher performance

As temperatures, pressures and complexity of ducting systems for ultra-sonic aircraft and missiles increase, weight limitations become proportionately more stringent. To solve these problems, Solar Aircraft Company has been developing new design concepts and advanced fabrication techniques. All of these concepts and techniques are currently being used in the development and manufacture of pneumatic systems for America's most advanced aircraft.

Weight Presents Problem

Without exception, design requirements are extremely critical in the areas of weight, temperature and pressure. An idea of the scope of



the problems encountered can be visualized in one current system. If it were built entirely of the lightest gauge aluminum it is currently practical to fabricate and if conventional insulation were used, the system would be more than 100 pounds overweight.

Weight isn't the only problem. Temperatures in this system go up to 1200°F, pressures reach 450 psi. Conventional materials and methods are made obsolete by ultra-sonic aircraft. Solar research, engineering and manufacturing teams with 15 years experience in the field of aircraft and missile ducting have developed a number of feasible approaches to the problem. One is an air film method of insulation to contain the heat of the air within the ducting system by means of an air gap between an inner and outer wall. As part of this insulation concept, Solar research has developed a special high emissivity coating. Called Solar black silicone, the coating has an emissivity rating of .89 on a scale of one

—higher than any similar material being tested.

Materials Offer Solution

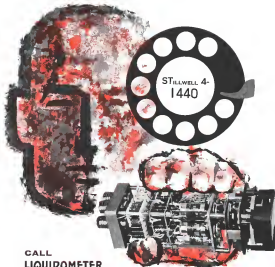
To solve the weight problem, Solar has been developing systems involving extremely thin gauge super-alloys and systems made primarily



of non-metallic materials. The company's extensive experience in the development and production of high pressure, long life-cycle bellows and gimbals has also contributed.

The ultra-sonic aircraft ducting program is only one of several now underway at Solar. They include development of the boundary layer control system for the Navy's new F4H fighter, engine ducting systems for an aircraft nuclear propulsion and ducting systems and components for the A3J attack bomber, F-102 fighter and C-130 cargo transport. In these programs Solar was usually given envelope size and centerline routing for the system, together with design parameters. Frequently, however, a system is designed by the airline contractor and Solar assists in the development.

For information about Solar's capability in the design, development and manufacture of ducting systems and components, write to Dept. J-161, Solar Aircraft Company, 2220 Pacific Highway, San Diego 12, California.



CALL LIQUIDOMETER for imaginative instrumentation —electronic and electromechanical

Liquidometer's long experience in electronic and electromechanical instrument and control systems, coupled with the will and the facilities to pioneer, offers all industry unmatched measurement and control. Let's talk about how we can supply imaginative instrumentation to support your full range of projects. Our ability in design, development, and production for a variety of applications in aerospace, mining, railroad, and industrial areas has already established Liquidometer responsibility. This revealing new brochure describes Liquidometer's comprehensive capabilities . . . just write.

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KNOW YOUR ALLOY STEELS . . .

This is one of a series of advertisements dealing with basic facts about alloy steels. Through study of the information in this series, you believe it will be of interest to many in the field, including most of those engineers who may find it useful to know facts such as these from time to time.

Cold-Finishing of Alloy Steels: The Cold-Drawing of Bars

Cold-finishing of alloy bars may be divided into two general categories: (1) cold-drawing, where the bars are pulled through a die with no surface removal, and (2) turning and grinding, and grinding and polishing, both of which remove the surface. Only the cold-drawing procedure is discussed here.

Cold-drawing is the process of pulling a pickled-and-laned bar through a die for the purpose of producing a bright, smooth surface finish, and close tolerances. The alloy bars are prepared for cold-drawing by pickling in a hot solution of dilute sulphuric acid for removal of scale. This is followed by a water rinse, and immersion in a hot lime-water bath to neutralize the effects of the acid, as well as to add an evergreen special liquid lubricants into the die.

Alloy bars may be cold-drawn in any of four conditions: as-received, normalized, annealed (ferritic or spheroidized), or quenched and tempered. These conditions are determined by the grade of alloy steel, the hardness, and the mechanical properties desired for a given end use.

In cold-drawing, the alloy bar is machine-pointed to reduce the size at one end so it will pass easily into the die opening. Otherwise, the bar is pushed or extruded into the die by an auxiliary device. A die-holder, which can be made to contain from one to four dies, is mounted in an appropriate head assembled across a "draw bench," so that from one to four bars can be drawn at the same time. The draw bench has a bed which accommodates a forked buggy with jaws that

grip the pointed ends of the bars as they emerge from the dies. The buggy has a hook on one end which engages an endless chain, thereby pulling the bars entirely through the dies.

After cold-drawing, each bar feeds automatically into a straightening machine, and is sheared or "cracker-cut" to length on appropriate machines. Saw are used when the cross-sections of the bars are too large to be cracked or sheared, or when square ends are required.

Smaller sizes in the form of rods are drawn on "bull-blocks" or "wire-blocks," depending on sizes, followed by straightening and cutting on special machines.

Specifications for chemical composition, grain size, hardness, and the like, of cold-drawn alloy steels have been given long study by Bethlehem metallurgists. If you would like suggestions on cold-drawn products, or any other problem concerning alloy steels, our metallurgists will be glad to give you all possible help, without cost or obligation on your part.

In addition to manufacturing the entire range of AISI alloy steels, Bethlehem produces special analysis steels and the full range of hot-rolled carbon grades.

This series of alloy steel advertisements is now available as a compact booklet, "Don't Pull on Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.



for strength
... economy
... versatility

Microdot Establishes Scientific Center

LOS ANGELES, CALIF. — Establishment of a Microdot Scientific Development Center in San Diego, California, has been announced by Microdot president Robert S. Dekker.

As a result of Microdot's San Diego Division, the Center will be managed by Harold G. Greenbaum. Two members of the Microdot board of directors, Dr. Joseph Kaplan and Mr. Harold A. Leshner, will serve with Mr. Greenbaum in the management staff. Dr. Kaplan, internationally known physicist from UCLA, is scientific advisor to the Center. Mr. Leshner, first vice president and director of operations, is responsible for all operations within Microdot Inc.

The new Development Center will be dedicated to the application of advanced electronics in expanding the technology of space measurements. The Center will conduct research and its subsequent program under contract to the major aircraft, missile, and nuclear agencies.



Unique physical dimensions produced by Microdot Inc. are tested in cryogenic temperatures at the company's Scientific Development Center in San Diego, Calif.

To perform these tasks, the Center will draw on the total capabilities of Microdot Inc. in North Pasadena and San Diego. Included on the technical staff are 61 engineers plus their supporting functions, organized as the Management Group, Instrumentation Group, Measurement Group, Magnetism Group, and Cable and Connector Group. Technical advances include Dr. B. D. Middleton and Dr. F. J. Mulla, both of the California Institute of Technology.

Typical of the current progress of the Center is the \$200,000 superconductor measurement system contract being conducted for The Martin Company. Under the contract, solid state designs of highly sophisticated telemetry equipment were developed and are being produced for use on the advanced version of the Titan



TALK IS NOT CHEAP

To negotiate the Cold War requires two costly elements. A position of undeniable strength; and time.

That's where defense comes in. To provide the strength. To buy the time for reason to prevail.

It must give us pause. For we in the defense business must realize that what we do keeps fingers off buttons. Because the real business of the defense business is survival.

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Export Sales — See Bethlehem Steel Export Corporation

BETHLEHEM STEEL

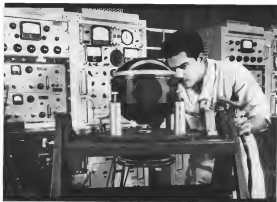


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ASTRODATA's new automatic tape preparation system prepares sets of tapes needed for AN/GJQ-9 missile checkout faster than any other equipment available. Tape feed is *environmental* in the Astrodata system—in exclusive format which eliminates rewinding and allows multiple duplications with high efficiency. You can punch, verify and duplicate at speeds to 60 characters per second; you can verify and duplicate at the same time; you can duplicate with or without verification; and you can punch 5A, 6, 7 or 8 levels of tape simultaneously without modification.



MAIN RACK of Astrodata system prepares two readers, a perforator, a printer, control logic circuit cards, and manual printer support. Rack is connected to keyboard console by four cables.

Prepares Perfect Tapes You will find it difficult to prepare working test perforator tapes with Astrodata's system. It automatically detects both its own errors and operator errors and will not function if you hit the wrong tape character on the keyboard. The system is performance proven; all components are of established reliability.

What the System Does The Astrodata system produces paper, photo or foil tape from a keyboard which includes making indexes. The system makes the completed tape, duplicates it, then "verifies" or retests the duplicator. During tape performance, detected characters are displayed visually and also printed out at 4 lines per second. Test statistics, errors and hit patterns in each reader are also displayed.

Variable Operation Astrodata's system will search for a selected set number and stop at the beginning or end of the selected set. While searching, the system will perforate/print up to the beginning or end of the selected set. It will search for a selected set and after finding it will perforate/print that set, or perforate/print after that set. With minor modifications you can use this system for any automatic electronic program.

Accepts Inputs from Other Devices Circuits are provided so you can perforate/print/display tape information from such external sources as buffers, magnetic tape units, computers, etc.

More Data Available For descriptive literature, please write to Astrodata, Inc., 340 E. Palmdale Rd., Anaheim, Calif.



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PIPELINE IN THE SKY

Riddle Airlines Inc. are flying Argosies up to 13 hours daily on the U.S.A.F. Logair routes. Logair is one of the world's largest scheduled cargo operations — an aerial pipeline for the quick supply of urgent military equipment. From coast to coast these new Armstrong Whitworth aircraft speed outside military loads in their capacious 47 ft. long holds, over a network of routes covering the U.S.A. Daily schedules bridge more than 92,000 miles.

Soon, B.E.A. will be doing the same on their all-freight routes. Argosies will open up new high-speed supply lines for outsize cargoes between the U.K. and Europe.

An Argosy fleet means high speed delivery, reduced warehousing, less packaging, less handling time, less shipping cost and — above all — unusually large freight dimensions.

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THEY RELY ON RADIATION for a unique low power PCM telemetry system in Nimbus

When Nimbus—the meteorological Satellite System being developed by the Goddard Space Flight Center of the National Aeronautics and Space Administration—begins sending its global weather reports to earth-bound meteorologists, a Radiation PCM telemetry system will prepare data on the status and condition of the satellite for transmission. Other Radiation-produced systems in the Nimbus ground stations will process these data.

Inexpensive in the spaceborne system will allow power to governments to a fraction of that needed for current PCM equipment. In fact, data from 650 transmitters will be digitized with only 1.0 watt... compared to many times that required by present systems.

The idea is as simple as turning off the lights in an unused room; just switch off the power during the infrequent "rainstorm" between pulses. In operation, it won't be that simple, but

Radiation engineers, working under the first contract awarded for a satellite PCM system, achieved the result—and a notable advance in the state-of-the-art.

The Nimbus system embodies PCM experience dating back to 1954, when Radiation contracted for the first airborne PCM system. This fast-growing company offers attractive career opportunities in a broad spectrum of scientific and engineering specialties. For details on Radiation write Dept. AW-132 Radiation Incorporated, Melbourne, Florida.

Radiation is an equal opportunity employer.



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Coupling
in WEEKS?"

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Steam control line quick disconnect for various electrical equipment

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Quick-flow quick disconnect with automatic shut-off for process and return lines from heat exchangers

These special quick disconnects are examples of Aeroquip imagination and know-how in coupling design and manufacture. Each was designed to meet specific customer requirements. But two are also Aeroquip's latest development: custom a wide range of fields, temperatures, pressures, operating and performance characteristics. Whatever your fluid line connection problem, it can be solved quickly and effectively at Aeroquip. Visit the coupon below for full information.

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Aeroquip Corporation, Jackson, Miss.
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THE INSULATION WITH A LOWER CONDUCTIVITY THAN STILL AIR IS NOW AVAILABLE IN BLANKET AND TAPE FORMS FOR UNLIMITED NEW APPLICATIONS.

New Flexible Mem-K offers many special advantages. For example, it is the ideal way to lower prototype costs. You can test performance without the expense of special tooling. The flexible blankets lend themselves to bonding, lamination with reinforced plastics, section castings and as a component of insulation systems. For them, Mem-K can be fabricated to wrap around a cylinder, cone or other geometric shape. And, it is also available in 1/4" and 3/8" sizes for steel strands or as a sheet or web.

JOHNS-MANVILLE

Vol. 75, No. 25
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[illegible]

* Study controls aimed at providing multi purpose vehicle by 1966, size expected to be small

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Winnipeg the Best World City 23

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Winning the Race With Time

(An chief of the USAF Systems Command, Gen. Ronald A. Belcher has a unique responsibility for both technical and management phases of the complex system. His thoughts on this management phase of the engine-drive water transportation in the computer system, then the relatively new machine that breed them originally at the Arnold Engineering Club in Washington, D. C. November 1970 is hereby presented, unedited, except from its speech dealing with the management problem. —JRM)

The most pressing problem we face in the Air Force today is the problem of winning the race with time.

An Commander of the Air Force Systems Command. I am concerned with the technical aspects of new aerospace systems. This is a problem of management, for my responsibility is to balance the requirements of quality, cost, and time in order to ensure that the Air Force not only gets the systems it needs, but that it gets them on time.

This is not a problem that can be solved by its alone. The task of systems engineering, which is the pursuit of the speed of systems today, is a multidimensional one. It calls for the highest degree of cooperation between the military, industrial and scientific communities. And it needs strong public backing.

The challenge confronting us as a nation is an urgent one. The contest between freedom and freedom is not new—it is as old as history. But today the forces of freedom are organized as never before. The technology that combines us today is the most powerful, ruthless, and efficient that has ever been in being. Its frantic drive toward world domination poses a continual threat to the free world.

This means that we in a nation must not ourselves for a long contest with a ruthless adversary. To wage this contest successfully, we must not only be strong, we must also be perceptive. Adequate military strength—now and in the years to come—is our best guarantee against armed aggression. It is here that our national policy, because it governs the direction of ideas to be created on military research to war.

The Soviet Union has devoted to arms a determined, unrelenting effort to attain military superiority through the use of science and technology.

The Soviet emphasis on military technology has placed our nation in an intensive and serious technological competition. It is a contest that we can not lose.

We will not win this contest if we do not continue our efforts that we can win on "business as usual." On the other hand, we will not win it through a series of frantic "crash" programs. We no longer have the problem as we did in the Second World War of meeting a relatively short-term threat. Instead, we must prepare for a period of intense effort that will last for the rest of this century.

To put it in other terms, we are neither taking a knee-kick, nor the cowardly nor quivering in the 100-year dash. We are in a different kind of race—a marathon race. This is a contest that demands not only speed, but also patience, determination, and endurance.

The pacing factor in this contest is not technology. It is management. It became more critical than during our experience in the latter world war, and now, because I have encouraged the rapid application of the management principles we learned at that time.

But the challenge we face today is far greater than the

challenge we met in producing the ICBM. Our task has drastically increased in both size and complexity. Moreover, the nature of the space age is extending the size and scope of operations that can be used in a potential crisis. All of these factors demand that we get our management to the long-range task of producing the systems we need for defense.

Our goal is to make advances in management techniques commensurate with advances in weapon technology. Only in this way can we insure the most rapid and efficient transfer of technology into capable weapon systems.

We are taking greater interest in source selection and in the control of subcontractors. In this connection quality control and reliability are major areas of concern. It is especially in these areas that we must ensure that a craft cannot follow the pattern of quality control systems versus rapid progress. As we move out into the conquest of space where level vacuum, radiation and temperature extremes are encountered, new standards of reliability are critical.

One of the keys to effective management is information, and for this reason we are developing a number of techniques for obtaining, processing, and displaying information rapidly.

Our present efforts regarding system studies are of rapid communication equipment to provide individual reports on weapon system status data reports on missile test activity, tank status, repairs and a number of problems and anticipated problems on designated systems.

In the field, we have enhanced reporting systems such as Champion, a system for real-time missile launch in progress and Control, a control system for following of progress, most critical and important, from issuance of a purchase request to completion of a contract.

It is not enough merely to acquire information. We must also be able to use it in the process of production and control. For instance, when the cost implications of a program are analyzed, stretched-out, or completed? What will be the difference in terms of delivery of the rate or amount of expenditures is reduced or increased? What are the implications in terms of time and cost if the objectives or end products of a program are changed?

But even so, every technology we need to build a fast "trial and error" system in these questions. At present we are working on a new programing and control system that uses computers to obtain "links of magnitude" answers in system results, thereby allowing us to detect and to potential deviations from planned programs as they are made.

All of these techniques will enable us to manage more effectively, which is another way of saying that they will help us win the race with time. But significant techniques will not solve our management problems. We need people who will make them work. The essential factor in any program is the participation of dedicated people who know their jobs and are committed to getting them done.

Along with this most fundamental in our methods of management, we must have a renewed dedication to the task ahead of us. For the pressures of time are likely to grow greater, not less, and the Government drive toward world domination shows no sign of slackening. We are in for a prolonged and severe test of the democratic system and its ability to cope with the problems of a complex and changing world.



BURGOYNE IGNORES RECONNAISSANCE AND INVITES

General "Gentleman" John Burgoyne was not one to fret over reconnaissance. Saratoga, frequently called the turning point of the American Revolution, was the end product of a series of "so inconsiderate" battles fatal to Burgoyne's invasion force. Supremely confident as he swung southward from Canada, the British commander rarely knew where or what was ahead. Sir Leger's British force, well chosen in Burgoyne's design, disappeared when its sizable Indian contingent vanished at news of a huge American counter force. Reconnaissance would have readily shown the Americans trailed a mere 1,000 men. Along his march, Burgoyne dispatched his pioneers to reinforce a Hudson advance unit at Westpointe, in case, without adequate reconnaissance. The pioneers did not disappear until after they were decimated by a Colonial force that the British had already been wiped out. Finally,

DISASTER

Burgoyne's confused and weakened rees, forced to retreat, were completely ignorant of enemy forces, surrounded at Saratoga. Throughout the history of warfare, successful field commanders have based conquests on proper reconnaissance. Burgoyne ignored history and the obvious need for strategic and tactical reconnaissance thus committing a series of deadly command decisions and helping to assure the success of the American Revolution.

From the beginning of reconnaissance on the face of the earth, reconnaissance has helped shape history. Today CAA's specialty in this area is helping shape history to the advantage of the Free World. Types of CAA reconnaissance are: V.I.P. Visual Integrated Reconnaissance; day/night systems; KA-50; the world's most visible line of cameras; BOLD; the only electronic optical "invisible ray" guidance system.

Industries, government and contractors at CAA



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WHO'S WHERE

In the Front Office

Gen. Thomas Donner White (USAF) will shortly become the new Air Force chief of staff. He will be replaced by Gen. William E. Momyer, who will be replaced by Gen. William E. Momyer, who will be replaced by Gen. William E. Momyer.

F. W. Goetz, Jr., retired president of the American Association of Airline Pilots, will be replaced by Gen. William E. Momyer, who will be replaced by Gen. William E. Momyer.

Dr. David W. Engstrom, retired president of the American Association of Airline Pilots, will be replaced by Gen. William E. Momyer, who will be replaced by Gen. William E. Momyer.

Robert E. Sweeney, president and chief executive officer of the American Association of Airline Pilots, will be replaced by Gen. William E. Momyer, who will be replaced by Gen. William E. Momyer.

Dr. Joseph A. Bond will become vice president and general manager of the American Association of Airline Pilots, who will be replaced by Gen. William E. Momyer, who will be replaced by Gen. William E. Momyer.

Mrs. W. H. Hester will join the National Aeronautics and Space Administration as chief of the Office of the Secretary of the American Association of Airline Pilots, who will be replaced by Gen. William E. Momyer, who will be replaced by Gen. William E. Momyer.

Honors and Elections

L. Eugene Rasmussen, president of Lockheed Martin, will be elected to the American Association of Airline Pilots, who will be replaced by Gen. William E. Momyer, who will be replaced by Gen. William E. Momyer.

Gen. Robert E. Peck, Deputy Chief of Staff, will be elected to the American Association of Airline Pilots, who will be replaced by Gen. William E. Momyer, who will be replaced by Gen. William E. Momyer.

Edward V. Appleton, secretary and treasurer of the American Association of Airline Pilots, will be elected to the American Association of Airline Pilots, who will be replaced by Gen. William E. Momyer, who will be replaced by Gen. William E. Momyer.

George R. Galt, Jr., president of the American Association of Airline Pilots, will be elected to the American Association of Airline Pilots, who will be replaced by Gen. William E. Momyer, who will be replaced by Gen. William E. Momyer.

Nathan R. Koenigsberg, president of the American Association of Airline Pilots, will be elected to the American Association of Airline Pilots, who will be replaced by Gen. William E. Momyer, who will be replaced by Gen. William E. Momyer.

(Continued on page 10)

INDUSTRY OBSERVER

British cabinet and top officers of the Royal Air Force, Army and Navy are developing a five-year program of the United Kingdom's defense posture for a White Paper scheduled for next year. One area of uncertainty is an Admiralty study of what it defines as a "Polaris-type" crisis for nuclear resources.

First Conquest 900 with modifications aimed at boosting top speed by at least 20 kt. to meet its greater fleet work. Modifications include a new wing leading edge and faired-on engine pods.

New techniques for detecting nuclear explosions which is based on the geostrophic disturbances that result has been proposed to Atlas-Sigal Corp. in Alhambra, Calif. The company is expected to be awarded a contract for the development of a hydrographic system in the low or bottom of the atmosphere.

First production set of advanced surveillance equipment designed for Greenham Common intelligence system of the Ministry has been ordered by a prototype equipment, but Area's evaluation has been delayed by a shortage of support equipment and probably will not begin before January. Greenham, which will build 17 ALCMs for Area, plans to install a variety of sensor devices but the company may reject and bulk of this equipment must be reduced before any overall can produce a multiplicity of functions.

New techniques used for Mexico rapidly recover, now are equipped with flotation bags in each bay of the engine, in case, it fails with about 100-150 ft. of the rubberized bag is loaded in each's lifting bag, along with the left side. Bags were tested for the recent May 5 flight (AW Dec. 4, p. 27) but were not needed because recovery, it's available in a distress.

Technique for continuously monitoring condition of solid-propellant rocket motors without requiring that they have a storage position, is being sought by Air Force Flight Test Center. Companies with competence in the technique will be invited to bid on a feasibility study.

NASA headquarters is expected to push a decision soon on the proposed Sarsen-C program, which calls for a lunar orbiter that would take pictures of the lunar surface in direct support of the Apollo program. The program is being developed by the Langley Research Center, which is expected to be awarded a contract to develop the program.

Area's ultimate light observation helicopter (LOH) is expected to incorporate a number of design details and components developed by Bell, Hiller and Hughes, the three firms selected to produce the aircraft for use in testing. Final LOH configuration will become operational in 1965 rather than 1964, as originally planned. Delay reflects a decision to await the results of an assessment of the program.

North American Aviation has issued a large number of potential risk estimates in its Downey, Calif., plant to include the Apollo program (AW Dec. 4, p. 31). Briefing notes for potential risks are being circulated.

Strategic Air Command is considering abandoning or slowing its internal combat competition (AW Dec. 5, p. 91) and has asked subordinate units for recommendations. Possible alternative would be competition only through the command's Air Force level, with bombers and tankers staying from their home bases. For the past two years, several selected in unclassified Air Force observations have been sent on temporary duty to a single SAC base to compete for overall championships in bombing, navigation and air refueling.

Sevens has proposed use of the Altair turboprop engine for the future M-21 (Helicopter 24 fighter). The Altair 9000s the M-21's 414 hp (AW Dec. 5, p. 91) and has asked subordinate units for recommendations. Possible alternative would be competition only through the command's Air Force level, with bombers and tankers staying from their home bases. For the past two years, several selected in unclassified Air Force observations have been sent on temporary duty to a single SAC base to compete for overall championships in bombing, navigation and air refueling.

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Washington Roundup

Missile Budget Shifts

President Kennedy last week approved the Defense Department's request for approximately \$51 billion for Fiscal 1963. Last month's changes included elimination of funds for cruise Missiles (see p. 26). Official explanation is that technical and operational problems were too great. The missile would have required development of a new guidance system. Defense Department will ask instead for a balance of Guided Missiles as well as mobile submarine-launched Polaris missiles.

Money for the new solid-propellant medium range ballistic missile (MRBM) totals about \$420 million through Fiscal 1963. But initiation of development has been delayed by Navy's report that it needs the capability of being airborne. Also still very much enmeshed in the question of control over missile warheads since the missile will be deployed chiefly by NATO nations.

Senators were asked for the recent movement of more than 50 Verol H-3HC helicopters, more than 50 North American T-28 Tanagers and 400 Army pilots and support troops be converted to jet aircraft carrier in South Viet Nam. But the ship had to be moved as it was 44 mi. up the Saigon River with its deckload of helicopters and aircraft vessels, to thousands of accidents.

Partridge Report

Report prepared by retired USAF Gen. Earle E. Partridge went beyond his original charter of studying a national command and control system. The report is now being reviewed by the staff of the Joint Chiefs of Staff. Current thinking is that the Partridge recommendation for a single operational military command would have to be supplemented by a military dispatch for the unified operational commands and member for the unified logistic and support agencies.

Meanwhile, Air Force is having second thoughts about the single source it has sometimes advocated—probably because it is not as clearly the dominant service as it was when Strategic Air Command was unchallenged as the strategic striking power of the U. S. Some top USAF officials now see significant advantages to the service in individual service identity. A single chief of staff is still favored, however. Navy is sticking firmly to its position that the Joint Chiefs of Staff system is best and Army is reluctant to see change.

Barton P. Brown has been named assistant director of defense research and engineering for the defense. He was manager of missile detection systems development for General Electric's Hewlett-Packard Electronics Department.

Foreign Carrier Permits

No strong case in support of domestic airlines, which have capacity limitations on foreign carriers serving the U. S., has developed so far in hearings before Civil Aeronautics Board Chairman Edward Steinhilber on the terms, conditions and limitations of foreign air carrier permits. Testimony has revealed that a number of foreign governments are seeking capacity of U. S. lines, but that air in a number of air ports capacity remains was given in supporting air in the investigation for lack of evidence. Foreign carriers were disappointed that Senate Department deferred voting its position until the case goes to the full board. They felt it would take the stand that capacity restrictions violate bilateral agreements between the U. S. and other countries.

Civil defense funds in the Fiscal 1963 Defense Department budget will be \$700 million. Of this \$400 to \$600 million will go for command and control and national defense. Defense has increased shelter areas capable of holding 50 million people will serve enough to hold another 20 million in the next fiscal year.

Retrograde Satellite

Retrograde satellite discussed recently in an embryo orbit around the earth has turned out to be Raytheon's Lark 1, which the U. S. thought had burned in the earth's atmosphere in April of 1960 after photographing the backside of the moon. Astronomers have photographed it and an effort is under way to prepare satellite tables.

Italy, Brazil and Canada have been invited by National Aeronautics and Space Administration to have their aircraft take part in experiments with American Telephone & Telegraph's Tether communications satellite next April in Mexico. Great Britain, France and West Germany, who already have agreed to take part, also were invited and a number of other countries have shown interest. NASA says.

The doors also are open for Russian participation and State Department will welcome discussions. But so far the Soviet has not indicated any interest.

NASA has informally told Defense Department it is receptive to any research and development requirements Defense might want to add to the two-man Mars program (see p. 26).

Fred Kothe, new secretary of the Navy, has another accomplishment besides law, banking and his previous service in positions with the Air Transport Command and in units with the Army (see p. 34). He is vice commander of the 14th Warship Squadron of the Air Force Area.

—Washington Staff

Manned Space Flight Program Expanded

McDonnell to build 12 two-man capsules and modify four Mercury spacecraft for flights of 18 orbits.

By Edward H. Kolczak

Washington—National Aeronautics and Space Administration is moving quickly to its advanced manned space flight program with tight production and flight schedules calling for extended two-man earth-orbiting missions within a year and two-man missions in two years.

First NASA approval has been given for two new concepts to fill the gap between the completion of three-seat Project Mercury flights and the start of Project Apollo qualification missions. The approved interim program, under consideration for the past six months, consists of the following:

• **Modification of four standard one-man Mercury capsules** into flexible manned versions, the first of which has been scheduled for late next year.

• **Construction of 12 two-man spacecraft**, which will be Mercury configurations 145 ft long in 11 dimensions that the existing capsule does through.

Flights will start in 1961. Although the program has a number of contracts, it is being designed primarily to develop and prove out the rendezvous technique which NASA hopes to use for Apollo before landing missions (AW Nov. 18, 1960, p. 70).

McDonnell Aircraft Co. is now in contract for the existing capsule, valued at \$500,000 for studies and detailed

design work on both vehicles. The company will receive a \$1.7-million contract to modify five production capsules for 15 orbit flights, and a new contract to build 12 two-man spacecraft.

Total Cost \$250 Million
NASA and McDonnell are now negotiating the \$250-million contract which has an estimated value of \$200 million. The space reports to spend another \$100 million for studies, the Martin Marietta 2 Tracker and the Gen and Dynamics-Lockheed Atlas-Agena.

In its preliminary development program, NASA will use a modified Apollo B stage as a target and the two-man

spacecraft as the chase. First flights will be capsule system tests, and six duration missions will follow.

The two-man spacecraft program has been called Mercury Mark 2, but this designation has been rejected and a new name will be selected. The program will give the U.S. its first operational spacecraft, with vast potential for both scientific and military use.

The NASA program has tactical objectives similar to the Air Force Steel (satellite intercept) program, in that the Agena stage and the rendezvous technique are involved in both (AW Nov. 18, 1960, p. 70). The steel hunt program will be announced.

In addition to developing and proving the two-man capsule will be used as a test bed for components to be used in Apollo and other advanced programs. Components of the Spacecraft and Flight Mission (NASA's Manned Space Flight Office), and access down in the outer structure will allow management of subventions and subventions, determining the need to fit into the spacecraft.

Low, said that the greater need arising at the pilot compartment in the light vehicle will be configured in a rectangle, with subventions for the most part installed outside the compartment. The standard Mercury capsule, which most subventions installed inside the pressure vessel, and that is highly unsuitable.

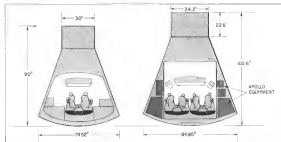
In both techniques 14 days to repair a leak in the capsule would not find help for the Mercury-Mark 2 flight (AW Nov. 20, p. 17) because it could not be fixed on the launch pad.

Most two-man spacecraft components will be larger versions of existing Mercury components. This means, Low said, that when Apollo hardware is ready for test, it can be substituted piece-by-piece without going into a major redesign.

Descent to go ahead with the larger Mercury capsule means NASA can make direct flights with major subventions. In most cases, the Mercury and the scale would launch data will be applied to the two-man vehicle design, and extensive serious testing will not be required. First duration have not been reached on speed of the major subventions, including pilot capsule and recovery.

Low said the two-man capsule probably will incorporate computer units so that an escape route exists to that the Mercury system could be eliminated. Use of disposable propellants in the launch vehicle is expected to reduce the likelihood of an out during launch.

If the flight-time was long, under study can be transferred into hardware.



DIMENSIONS of advanced Mercury capsule will be 14% greater than those of current model. Area between manned capsule and capsule structure will be used to test Apollo and other advanced programs components during extended two-man orbital flights. View of current Mercury capsule components are crowded into pilot's compartment.

Low said the two-man capsule is 11 ft long. The capsule design is also called "floating and pointing," and North American Aviation has Phase 2 study contract for this mission vehicle. NASA also is planning Mercury. The studies of its flight of concept, in which a big or used to make a prototype, is necessary.

The two-man capsule will be used in the spacecraft. Plans for the initial flights will be selected from among the various Mercury versions from Low and supplementing this goal program on problems. Additional two-man missions will be the X-15 USAF and NASA pilot tests to focus the planning for the USAF Thrust-100.

Advantages in both manned space craft and Apollo were that it would pilot Low and because there is a large number of scientific and medical facilities available among them, with flight equipment.

For some missions, the two-man capsule will carry along the target vehicle, using subventions, that will be used to extend the mission time of the existing Mercury program, in 18 orbits. After launch (chase) through the subventions, subventions, removal of the principle and backup subventions, and satisfaction of oxygen and power supplies in the Agena-Mark 2 capsule system.

Instead of remaining with the launch vehicle at separation, the capsule will be part of the orbiting spacecraft and will be separated just prior to earth atmospheric re-entry.

The adapter section will house pu-

lifiers for re-entries and initial or initial subventions in the two-man capsule in some missions. Initially, the subventions will be in the Agena-Mark 2 capsule and the time and for orbital control in the present Mercury version. Later, the capsule will use the subventions and the Agena-Mark 2 capsule.

Descent to proceed with the 5500 manned two-man spacecraft in a week's time development program could be viewed as the first official confirmation that NASA began the rendezvous approach with direct flight to the moon for Project Apollo. Direct flights and other subventions are in the Agena-Mark 2 capsule.

After exploring the manned space flight program, Dr. Sturges said, "To provide subventions in one or two, not able, to perform the mission on technique in time to meet our schedule, we have."

Saturn C-4 Engine

Washington—The use of a single 100,000 lb. thrust C-4 engine to power the first stage of the Saturn C-4 launch vehicle is under consideration by the National Aeronautics and Space Administration. The engine will be called S-8.

The C-4 vehicle will be a two-stage vehicle of a cluster of four Rocketdyne 22 engines in the second stage. The C-4 is now in the primary launch vehicle for emergency missions in the Apollo advanced launch landing program (AW Nov. 8 p. 30).

designed to begin development of the North American vehicle in 1961. We shall hang it along so that it will be available, if required for the manned lunar landing use for the moon subventions maximum into space that will lead to the landing on the moon.

Selection of the two interim manned spacecraft has resulted in a modification of plans to fit standard Mission with its support equipment to sustain man, machine, and a subventions on flights of up to 14 days.

Instead NASA plans to increase manned flights to ten beyond two weeks and eliminate the need for annual missions.

The first is a spacecraft project will be carried by NASA's Manned Spacecraft Center with John Chamberlain in project chief. Chamberlain's group is at Langley Field but will be in Houston, Tex. shortly. Although the center's management structure has not been defined, it is expected that it will include two small project offices—one for Apollo and the other for the two-man

The Manned-Titan 2 launch vehicle has a capability of placing a 6,000 lb. payload into a 100-mi orbit. The two-stage vehicle was scheduled to first in subventions, flight ring test (PFR) in, last week of Martin's Dyna-2 facilities. First flight will be made in January or February from the Atlantic Missile Range.

Against General Corp. builds the engine for the Titan 2 vehicle. The engine is based on a static liquid-propellant of 30% hydrogen and 90% oxygen, instead of the 75% hydrogen and 25% oxygen mixture.

Mobile Minuteman Is Canceled

Washington—Defense Department last week canceled the Mobile Minuteman intercontinental ballistic missile program, which would have deployed the solid-propellant weapons in railroad cars and entered the field of silo-based Minuteman mobile missiles currently in 1959.

Of an initial funding of \$100 million in the Fiscal 1960 budget about \$100 million has been spent on Mobile Minuteman. Further development was canceled last week by the Research Administration. Steps are now being taken to cancel all Mobile Minuteman contracts.

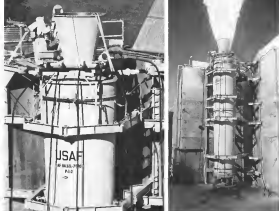
Funding paid for Mobile Minuteman was 60% of which about 100 were in the manufacturing program. As a result of the canceled program, the Air Force has authorized the program, estimated by the Defense Dept. to cost \$100 million to produce 600 units. Obligations for this production would not be made until Fiscal 1967. Budget report for Mobile Minuteman in that fiscal year is \$24 million (AW Dec. 11 p. 25).

As reported by the Air Force last summer, the program began in 1960. Mobile Minuteman would have included \$200 million in Fiscal 1962, \$270 million in 1963, \$355 million in 1964, \$990 million in 1965, \$645 million in 1966 and \$324 million in 1967.

The proposed Mobile Minuteman program began in 1958. In Fiscal 1962, \$24 million in 1963, \$24 million in 1964, \$24 million in 1965, \$24 million in 1966 and \$24 million in 1967. The program would have included \$200 million in 1968.

As of late last week there had been five attempted development flights of the Mobile Minuteman over the Atlantic Missile Range from Cape Canaveral. The first shot from a launching pad Feb. 1 was successful. The second missile shot from a pad May 14 was destroyed by the major engine when the second stage malfunctioned, although the first stage burned successfully. A July 17 shot blew a pad was successful even to range destroy.

The last attempt at firing from a silo was made Aug. 10. The last stage fired successfully and the missile rose from the silo shortly after which the second stage spent prematurely and exploded. A silo shot Nov. 17 was successful.



UNITED TECHNOLOGY CORP. technicians adjust fuel nozzle alignment on 96-in.-dia. solid rocket which was successfully fired. Segmented rocket motor developed 421,000 lb. thrust for a burning time of 79.51 sec. The 79-ton rocket motor was fired once down

Solid 96-in.-dia. Rocket Static Test Fired

By Irving Stone

Mesa, Ill. Calli-Flightweight prototype configuration of a 96-in.-dia. 48-ft-long, casacally segmented solid-propellant rocket motor-developed approximately 421,000 lb. thrust for a burning time of 79.51 sec—was fired in a one-time position on a vertical, static-test stand at United Technology Corp., a subsidiary of United Aircraft Corp., at its development center here.

Following according to procedures, the motor was ignited at the splash-out end of the preannounced firing time, after a 16-min. countdown to check out major functions in 127 channels of instrumentation for returning data on performance parameters.

Test motor designated P-12 was developed with United Technology funds, but the Iraq was funded by the Air Force under contract 64-61 7490 with 59901 Test Group (development), Edwards AFB, Hawthorne, Calif. Air Force Systems Command's Space Systems Division. The P-12 configuration was built the size of the P-1 configuration fired by United Technology on Aug. 5, 1965, under contract with National Aeronautics and Space Administration.

Little information was revealed by company officials on the specific characteristics of the P-12 rocket motor configuration, the size of the run to be developed as fired by the Air Force.

Little information was revealed by company officials on the specific characteristics of the P-12 rocket motor configuration, the size of the run to be developed as fired by the Air Force.

and fabricated by United Aircraft Corp. at Pratt & Whitney Aircraft Division.

•Nozzle, constructed on optimum level design, was about 8 ft long, largest diameter was approximately 5 ft. Engineers who are approximately "1 to 1" built in California General Ship, nozzle cut came had a steel intercooler mounted with a glass phenolic liner downstream of the throat which was composed of a three-quarter in. fraction carbon material and designed so that it can be welded onto the steel shell with large nozzle.

•Taper of the nozzle configuration from the maximum diameter of 96 in. to main throat probably not more than 1:1 deg. half angle.

•Propellant grain consisted 2 ft. probably the thickest grain ever cut in diameter, so that the design of the propellant was practically negligible, in an eight nozzle case.

•Core was a time center cross-section, hence for minimum stress concentration. Thrust has been tested this one

configuration, and it is likely that it will be followed in future motor designs, considering the success of the United Technology firing.

•Propellant was identified only as a high performance solid propellant, composed of but it is known in the industry that United Technology is working with, and probably used for this firing, a rubber-bas, polybutadiene, acrylonitrile (PBAN) fired glass-reinforced polybutadiene in an oxidizer. Propellant probably contained an aluminum powder, to give specific impulse a minimum percentage in the industry, and used in the solid propellant of the Minuteman (ICBM). A chemical additive probably also was used to resist burning rate.

•Specific impulse of the fuel also was not revealed, but safe confidence is that a value of 245 sec was obtained. Its function is that the fire has been getting this high, consistently in terms.

•Grain pressure, also not revealed, probably would fall somewhere between 500 and 750 psi at sea level for a motor of this type and size.

•Igniter was a United Technology, designed small rocket motor, adopted specially for this firing.

•Thrust vector control by fluid injection probably was used, since reasonable control is difficult to obtain in small scale laboratory firing, although UTC officials would not comment on whether thrust vector control was used in this particular firing.

Thrust vector control research is important of prime importance in the development of large solid-propellant rockets, such as the 96 in. dia. unit fired here and those of larger size contemplated under the 120-in., 156-in., and 240 in. rocket motor program in the future for Air Force and NASA use, respectively.

Thrust vector control investigation is involved in the special research work, which has and been completed by Aerojet-General (Lockheed) Propulsion Co. and United Technology with

the 699th Test Group (Development), Edwards AFB (AFW Dec. 14, p. 28).

Propulsion companies are investigating both force (as well as) and vector control for thrust vector control. It is likely that a considerable amount of time is being spent on an opportunity to obtain a substantial amount of thrust in the vector, by means of the nitrogen tetroxide with the liquid oxygen in the oxidizer stream.

Industry estimates are that perhaps 95% of the rocket motor test thrust was obtained with thrust vector control a variable input for an analyzer which the force fraction of which is to direct the vector.

Post-Firing Appearance

Within a reasonable time following the firing, the motor case was cooled, the bands indicating that the interior surface of the steel shell also was cooled, or the heat would have melted through to the outside. External paint also was intact. Significant grain surface cratering was not seen, since there was water saturation in these areas. No movement of the joints was indicated upon inspection, and following the firing time, was no evidence of joint separation.

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New Power Source For Space Is Shown

New type of cubic electric power source, an electrochemical power source, which shows promise as a high-voltage, high-power source for portable space vehicle use, has been successfully demonstrated by General Electric's Missile and Space Vehicle Department.

Although the principle of electrochemical (EC) as not new, GE says it believes it is the first to operate a unit which produces more electricity than it consumes. The present open-circuit voltage is about 1.4 volts, with 175 volts load, requiring only 0.1 milliwatt electricity from an outside power source, GE says.

The new EC converter bears some resemblance to the mercury-iodine source (NIID) converter under development by Aero, GE and others. Both types are expected to produce extremely high power levels, possibly in the megawatt range, with a high ratio of output power to weight.

The NIID converter uses a plasma moving through a magnetic field to generate electricity, which is then converted to a direct current, with the plasma serving as the conductor. The new EC converter's operation more closely resembles a vacuum tube. In the EC device, a stream of ionospheric air is ionized through a plasma ring containing a pump. A voltage is applied across the ring, and ring voltage is used to ionize the air as it passes through the ring.

The resulting electrons are drawn off by a collector ring, which is connected to the positive terminal of the collector. The electrons are then pulled down to the collector ring by a collector ring, which is connected to the positive terminal of the collector ring. The electrons are then pulled down to the collector ring by a collector ring, which is connected to the positive terminal of the collector ring.

In the present experimental model, the separation between anode (positive) ring and collector grid is several centimeters, according to John South, chief of the system, located in the department. The company is expected to produce what power outputs and all energies may be achieved, but there is no doubt that an output of 30 watts could be obtained with an emission ring size of about one square meter.

The output voltage, is proportional to the distance between the two electrodes, the density of the ionized particles and to the resistance of the load. Present calculations indicate that the maximum voltage may be obtained, suggesting that the new EC converter might be useful for powering ion engines in space vehicles.

Scout Motor Development Problems

Washington—Series of problems in development of the advanced fourth stage Scout motor has caused the National Aeronautics and Space Administration to set a second review and development program for the motor, developed by Thiokol.

Thiokol's problems, which has the contract for both third and fourth stages of manned and advanced Scout vehicles, said the problems are normal in advanced propulsion program and schedules are anticipated within the next few weeks. However, Thiokol says NASA would delay the development, but NASA and prospective bidders are being asked that the second contract may not be fulfilled if Thiokol cannot solve the problems.

Thiokol said the new motor design has demonstrated its principal performance parameters.

The N150 is to have a 20-sec. burning time and a thrust of 4,000 lb. It will replace the N140-Aero, which has a 30-sec. burning time and a 1,000 lb. thrust. NASA's Launch Vehicle Center made a contract for the development of the motor and development on three configurations of an advanced Scout fourth stage. The three configurations are for various payload vehicle shapes.

No. 3 X-15 Is Ready For First Test Flight

Los Angeles—First flight of the No. 3 North American X-15 with a newly designed Minneapolis-Florenceville adaptive control system will be made in a series of three flights from the Lake at Edwards AFB, Calif., beginning on the 15th. The lake surface has been affected by recent rains, making the 15th flight program. It is not out of the question, a major flight about the flying B-52 aircraft carrier would be made to check X-15 return.

The No. 3 aircraft was partially destroyed in an explosion in the propellant tank June 1, 1960. It was rebuilt by North American and returned to the post NASAMAF-Navy project last September. It was never flown before the explosion.

The first mission will be flown by NASA Test Pilot Neil Armstrong. Performance points will be limited to 2,400 mph and 75,000 ft altitude. Because the mission is extended to include the first X-15 flight test with the adaptive control system (NAV No. 2), a 95% engine power will be limited to 50% of its 17,600 lb rated thrust during the 10-min powered flight segment. The entire flight will last one hour.

Except for a 350,000-ft design altitude flight, most future high altitude X-15 flights will be made by the No. 1 aircraft. It will also be made to test new tactics.

RAF Orders AS-30 Missiles From Nord

Paris—Need Aircom ordered its first export order for its AS-30 air-to-ground missile with a \$16 million order placed by Great Britain.

The Nord wanted as a competitor of the Matra R530. The AS-30 travels at supersonic speeds and can be fired from almost any day, especially at the time of launch. Body length is 11.5 ft and range is about seven miles.

The AS-30 currently is being tested produced by Nord for French as well as in all other possible export markets. Nord hopes to capture much of the European market for air-to-surface missiles from Matra.

Nucleus Contractor

General Electric has been selected by Air Force Electronic Systems Division to develop new nuclear reactor control systems, known as Nucleus, as it is needed to protect any of nuclear destruction within the continental U.S. Denser reactors will be a major nuclear source on the program.

PERT Contract

An Air Force Electronic Systems Division is working agreement expressed in February. Evaluation Review, Torrey, DIRECT, for a short-term contract to assist in applying PERT to some of its command and control system development programs.

Defense Gets Protest On N.Y. Contract Loss

Washington—New York's congressional delegation last week protested what it called the "staggering losses" in the state's share of military procurements, from 12.5% in the third quarter of 1960 to 5.5% for the same period this year.

This was a net of \$241 million, or 40% of the state's military budget. In a letter to Defense Secretary Robert McNamara the delegation's steering committee, headed by Representative John J. Pickens (D-N.Y.), declared that the situation is "in itself, shocking when read in relation to the statistics reflecting the increasingly dominant role played by the state of California in three procurements: California's allocations rose from 12.5% of the total in the third quarter of 1960 to 21.7% for the first quarter this year.

Air Force contracts of \$625 million to California during the July-September period, 40% more than the \$464 million for New York.

Although a substantial amount of prime procurements are subcontracted, the letter committee contended, "it is not unreasonable to assume that procurements to the state of New York would be and will continue to gain by a more fair allocation."

New York State declared in defense budget following the letter was delivered in mid-1960 after a vigorous protest while its congressional delegation. While New York's share of defense contracts declined from 19% in 1951 to 11% in 1959, California's portion increased from 15% to 21%.

News Digest

First Keith, a Ft. Worth, Tex., attorney and businessman, has been appointed secretary of the Navy by President Kennedy to succeed John B. Connolly, Jr. of Ft. Worth, who was fired for gross misconduct. Keith, 52, formerly was assistant Air Force secretary and served as an Air Force lieutenant colonel in World War II.

General Dynamics AF957 flew successfully over the Atlantic Missile Range last week, setting a peak endurance of 25

minutes without fuel costs to test the effect of solid-fuel boosters on the rate at which the new boosters are tested. The earlier experiments have tested the effect of configurations on an early launch. Coxy was directed by Martin Marietta Corp. by Atlantic Energy Control Systems, Air Force Special Weapons Center was test coordinator.

Elmer Mitchell has resigned as assistant director of Manassas Space Flight Program for Propulsion, National Aeronautics and Space Administration, to be an independent consultant. He had been a Navy and NASA propulsion manager 19 years.

First Minuteman facility at Vandenberg AFB, Calif., has been turned over to the Air Force by the Army Corps of Engineers. Vandenberg has installed two launching silos and a launch center.

USAF-Lockheed Divergence 36 was successfully tested with a University of Texas report describing the program as a test of the "new" aircraft at the Georgia Institute of Technology. The program's experimental payload consists of a 100 lb infrared thermometer sending on 20,000 sec and 40 sec.

Control rooms and ground guidance of America's Western Electric Guidance Nike Zeus was ICBM test successfully tested at White Sands Missile Range in a launch with an inert payload in the first stage. The missile was launched from an over-ground missile launch facility and development test and launch center missile command and control. Also on the launch, the missile successfully launched and the first two stages of propulsion.

Good American Board last week granted Eastern Air Lines authority to operate the Toronto-Florida route and authorized Midwest Airlines to operate single-stage service between Toronto and Chicago. New York, then American and the airlines will be required to accept single-stage service between Toronto and Buffalo.

Last USAF-Martin T41 aircraft and development model was launched over the Atlantic Missile Range last week. The T41 was built from Ford's General Instrument in T41 test flight since 1959. The T41 was built by General Instrument in T41 test flight since 1959. The T41 was built by General Instrument in T41 test flight since 1959.

Brown & Root, Inc., of Houston, Tex., has been awarded a \$1.5 million contract by the Air Force and engineering design of NASA's Mars Spacecraft Center near Houston.

AIR TRANSPORT

CAB Plans to Expedite Merger Hearing

National-Continental proposal will test whether—or to what extent—Board will foster realignments.

By Gilman Gutman

New York—National Airlines Continental Airlines merger proposal is expected to arrive in an expedited hearing before the Civil Aeronautics Board (CAB) possibly to be processed by the Board within one month or a year.

The proposal, filed last week in the form of an aerial agreement between the two carriers, calls for the merger of National into Continental, with the surviving corporation to be Continental. However, the name of the merged company will be "National Continental Airlines, Inc." under the proposal.

Strongly significant to the airline is that in the case will be the two major points of the merger, the CAB as a whole, and whether the National-Continental proposal is CAB material for merger. Board Chairman Max B. Boyd has publicly expressed his merger is domestic freedom in probably the best solution to the problem of overcapacity, though he made it clear he will be hard to get the entire Board. Boyd said merger should be in the public interest, though he has a reasonable degree of opposition should result in better integrated route structures and smaller financial condition for the surviving carrier (NAV No. 6 p. 17).

The National-Continental proposal is expected to be opposed by at least some major carriers, and whether it meets the above conditions is likely to be a point at issue in the case.

Boyd said American "will be the primary party to be expedited in the time, and he estimated the time involved as possibly about nine months to a year. The two carriers, in their merger application filed last week, and the agencies will be required to appear in their respective boards of directors of a definitive agreement in order that preparations could be made for an expedited hearing. An expedited proceeding will be held, and as soon as a definitive agreement has been filed.

Every effort will be made, the carriers said, to consummate a definitive agreement within 60 days. Under the proposal, G. T. Baker chairman of the board of National Airlines, becomes head chairman of the new airline. Robert F. Siv, president of Continental, becomes president of the merged airline. R. J. Wiland, president of National, becomes first vice president of the new carrier and assistant to the chairman of the board.

Headlines of National-Continental stock, under the proposal, will be the two major points of the merger, the CAB as a whole, and whether the National-Continental proposal is CAB material for merger.

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under the agreement will receive 12 shares of Continental stock for each share of National.

Boyd expects last week, with holding further details of the probable flight arrangements, but financial and airline, under more, specifying about some questions concerning the deal.

Importance of Chicago-to-New York route for the combined airline. Continental has filed for route extension beyond Chicago. Without this extension, the new carrier would have a smaller gap in its route structure. It would fly from Chicago to the West Coast.

Northeast Air Cleared

Washington—U.S. District Court of Appeals has, in a 2-1 decision, but with opinion in block Hughes Tool Co. from getting emergency financial aid to Northeast Airlines to save the carrier from possible reorganization.

The decision was also clear the way for the stock sale of Northeast to Hughes Tool and an ultimate merger of the airline with TWA. The case was brought last week by Eastern and National Airlines to the court. The court's decision was clear the way for the stock sale of Northeast to Hughes Tool and an ultimate merger of the airline with TWA. The case was brought last week by Eastern and National Airlines to the court.

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In granting Hughes authority to sell Northeast the assets it needs to operate during the Florida route sale, the Board noted that it seemed clear that the sale of Northeast could result in control by Hughes Tool. During hearings preceding the CAB decision, a Hughes Tool representative said that Hughes Tool would not be interested in retaining and the merged airline it could gain control of the airline. Last week, Northeast and Hughes Tool were discussing a lease deal with the airline.

from the West Coast to the Southeast over the southern route, and along the East Coast from Florida to Boston, but would have no connection between the Northeast and the Midwest. With such a route only one, it would have two transcontinental routes. It was felt that National Continental Airlines would be too good to go for the route extension and would surely be through approval.

•Merger effect on national carrier would depend on addition to service equipment. This would include Continental Boeing 707-120, 720s and Vickers Viscounts. National's contribution would be Douglas DC-6s and Lockheed L-1049. National currently has Lockheed DC-6s on order. An equipment shift would seem to be inevitable.

•Disposition of 400,000 shares of National stock was held by Pan American. Pan Am has CAB order, submitted a plan which calls for disposition of this stock not later than July, 1961. Board Chairman of CAB has recommended against this plan, however, and it is likely that CAB will order Pan Am to divest at a date considerably earlier than 1964.

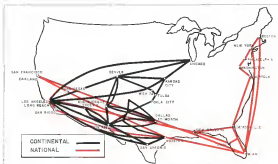
•Debt position of the merged carrier. Both airlines high debt ratio and merger would appear combine the two carriers. The new carrier will be larger but not immediately stronger financially.

Initial stock market reaction to the proposal was that National was at one point and Continental was at one point. This, in part, was a market reaction to being part of the stock in line with the merger terms.

National's opinion, according to financial sources, appeared more pessimistic about the plan than Continental's, and the market situation tended to support this pattern.

The multiple, equipment problem of combining National and Continental could possibly be solved by re-equipping with a modern or short-range jet to replace the turboprop, and industry sources are said to be possible. Trade in earnings could be useful to such a transaction. National has applied equipment interest in the Sud Caravelle and Six of Continental's was one of the first airline presidents to show interest in the General Electric-powered Caravelle. Six has expressed interest also in the BAC 111 jet British Aircraft Corp. doesn't regard Continental as a leading prospect for orders. Another controller could be Boeing 720 or 737.

General Electric of one point was



ROUTE SYSTEMS at National and Continental would, if accepted, result in an airline with 15,397 duplicated route miles.

willing to take Electric in trade to sell Cessna's lost sale, and use the resulting Thrush and Cessna Electric plan to send in a sales drive in the first half of this month and BAC is expected to make new progress in light of the possible sale route system.

As far as solving the problem of occupancy in continued, some observers note that a National Continental merger would be less beneficial. The two current companies only, over the Horizon West. Continental, which carries long routes with the western from continental route system.

National's western transcontinental routes, but enabled the airline to run the service from a recent loss. Low profile, long-range flight, and a new route to the West Coast and eastern air.

Sayen to Quit ALPA by June

Washington—Charles W. Sayen, president of the Air Line Pilots Assn., officially declared last week that he will resign next June 1962, and release any more effort to joining his line in office.

The decision will not be reversed. Sayen told Aviation Week last week, even if a flight is organized in a support of the airline's 14,700 pilots. The question of who will succeed him is to be settled in a May 27 board of directors meeting, called after the incumbent failed to be re-elected at ALPA's convention (AVN Nov. 5, p. 30).

Sayen and his business for "old and new to change his own program" and become he wanted to create an airline association for the next ALPA administration, he elected not to resign in December. But Sayen stepped down from the office of the board of directors meeting, Capt. John G. Smith, the airline's vice president, would have accepted the presidency automatically under ALPA's constitution. Officers of last year's president, assistant, and treasurer of ALPA as well as its president, will be filled by chairman selected by the May meeting.

industry and projects (AVN Dec. 23, p. 35). This move, which would be a joint cost to the combined airline, is to be the airline would replace the revenues of the individual entities one factor is the loss of annual flight miles between them. National's peak is in winter and Continental's is in summer. For example, Continental flew 98,153,000 revenue passenger miles in July 1960, and 79,777,000 in June 1961.

National's respective 1960 was 50,416,000 and 92,313,000. Then, these figures do not rise or contract the airline's transcontinental route, which has changed the seasonal characteristics associated. But, post-merger, the seasonal balance in the nature of a merged carrier would permit more seasonal expansion.

As to a combined carrier, it is to be

control of a merged airline, some observers feel the cost of acquisition of National or Continental is a high cost. But, as long as the airline is in the West, when it is in the East.

Present combined fleet of the two carriers totals 70 aircraft, including four DC-10s, 70 747s, and 720s, 11 F-100s, 18 Vickers, 11 DC-7s and 70s, four DC-6s and 40s, two C-46s, four Lockheed 1049 Constellation, and eight DC-10s.

Net worth of the two airlines is \$10,330,000, divided \$7,240,000 National and \$2,890,000 Continental. National assets of \$97,403,000 and Continental a \$79,906,000 total \$177,311,000. Mergers would create a large duplicated route, with a total of 13,797, of which 6,812 represents National's system and 6,985 represents Continental's. National's debt at June 30, 1961, totaled \$52,647,515, of which \$16,675,845 was in bank debt, and the current fixed cost of the continuing long-term debt \$37,768,215 was in mortgage, bank, and bonds. \$10,203,000 was in commercial, subordinated, debenture, and \$10,000,000 was in other debenture. Continental's debt as of Dec. 18, 1960, totaled \$52,647,515, of which \$6,463,449 was due, the remaining year-end payments have been paid. Total long-term debt for the two carriers, therefore, stands at \$77,718,112.

National's operating revenues for the first year ending June 30, 1960, total \$65,918,875. Continental's 1960 operating revenues totaled \$61,987,585.

Industry Group Predicts 1961 Loss Of \$30 Million for 11 Trunklines

Washington—Air Transport Association warned that the industry of 11 major trunklines industry lost 1961 with a net loss after taxes and interest of \$30 million for the year.

The estimate was based on the fact that of the 11 trunk carriers, five net losses—Eastern Trans World, Northwest and National—will record losses that would offset net earnings expected to be shown by the other trunklines—American, Braniff, Continental, Delta, Northeast, United and Western. The industry loss would be the highest in recent annual industry history.

Earnings Slip

Earnings before taxes was \$23.2 million reported in 1960. Since 1945, when the loss was \$4.8 million, the industry has shown a consistent profit, although last year net earnings reached a low \$1.2 million.

Traveling revenues in 1960 will reach \$2 billion, according to the estimate. This represents an increase of 45% over 1960. Operating expenses this year climbed 4.1% to slightly over \$2 billion.

Revenue passenger miles for the year are estimated at 29.5 billion, a 1.1% increase over the previous year. Coast traffic accounted for 57% of the total in 1960, compared with 49% in 1960 and 11% in 1959.

Airline's seat index rose to 104.77% to 129.19, despite the addition of 150,000 revenue passenger miles in the year. Annual capacity increase in cost has ranged from 13% to 25% annually.

Traffic Growth Decline

The decline in revenues was attributed to the ATA President Stuart C. Gipe to the sharp decline in passenger traffic growth and a substantial decrease of passenger load factor due to increasing costs.

The number of passengers carried by the trunklines dropped 2.7% while the

total of local service passengers carried fell 14.4%. The number of local service passengers declined 9.2%, while passengers handled by U. S. flag international airlines rose 5.9%. Passengers handled in Alaska routes remained about the same, while the volume of U. S. international airlines dropped a sharp 11%.

In the total scheduled airline industry, the number of passengers carried fell 1.7%. But average passenger miles increased 1.1%. Weight loss index was 131.0. U. S. flag airlines rose 27% and express loss index rose 51%.

The airline industry's share of the 11 month total was 30.1% to 1960, per 100 million passenger miles compared with 32.4 for the first 11 months of 1960 and 36 for the entire year of 1960.

Jet Orders

As of June 30, 1960, U. S. carriers have operating 501 jetliners planned transactions compared with 475 at the end of 1960. During the last half of 1961, 67 jetliner or turboprop aircraft were scheduled for delivery. Orders have been announced for 68 jets in 1961 and 40 in 1962.

The ATA report said that jet revenue passenger miles accounted for more than 50% of total airline revenue, and international passenger miles for the year total 1960, compared with 28% in the same period of the previous year.

Employment in the airline industry stood at a total of 471,000 persons this year and annual industry payroll will exceed \$1 billion, the ATA said.

American Submits New Fare Formula

Washington—American Airlines proposed to increase its revenues by raising fares in 1962, but it is in a good position to meet the industry's needs. The airline noted that present unit costs are higher for short hauls and profit margins are lower, and that it desired that first-class lines could be widened.

Meanwhile, the Board has voted to suspend until May 11 a series of transactions and jet expansion plans planned by Eastern World Airlines, Continental Air Lines, United Air Lines, American Airlines and Northwest Airlines. Board members are completing a final study of a variety of fare proposals (AVN Dec. 4, p. 31) and is expected to meet in June, perhaps, statement this week.

American, describing the continuing shift of airline passengers from first class to coach service as "a principal

SAS Warning

Washington—Opponents of U. S. flag airlines to launch airline competition on North Atlantic routes could block an attempt by this country to participate in the European Common Market. A San Francisco Airlines Association executive said last week.

Walter E. Krasner, first vice president of SAS, advised what he called the "covert" tactics of U. S. international airlines objecting to liberalized agreements and U. S. independence of the European Agreement participants.

He said that better efforts to limit foreign competition could also result in Europe being brought over into a common area. This would likely prevent any U. S. carrier from competing for passengers within Europe. Krasner said, "This is not to be ignored and it is the only way."

Krasner noted that North Atlantic is the "hot" ticket, but called for a study about competition at scheduled meetings to achieve these. Krasner has not a national basis of the International Air Transport Assn. could be used. The industry's present position of action and reports are that the industry is in a temporary state and could possibly be solved by having them to attract a higher volume of local traffic for all carriers on the route he said.

problem for all of the industry," and it is a realignment of its lines to the industry.

• Budget airlines long about 550 and current costs plus by a 32% amount to increase the present \$40 difference in transatlantic acquisition. For example, 1,700 miles, this difference should be about \$15. The carrier estimates, some experience has shown high overseas profit-loss, to the present price differential charged for flying on the same route.

• For prices of less than \$200 in America, also has been running the price spread, but did not suggest a specific amount. While there is some discussion as to the present difference in this area, it is in a good position to meet the industry's needs. The airline noted that present unit costs are higher for short hauls and profit margins are lower, and that it desired that first-class lines could be widened.

• All taxes should be published in even dollar amounts to simplify tariff filings and lower the costs of difficult accounting procedures.

• "Unpredictable advance phase" should be abandoned in Europe and international with suggested fare increases, growth. The airline said it favored dropping both the transatlantic vacation fare plan and the youth discount fare plan.

El Al Tests Group Fares as Traffic Builder

By Cecil Browner

Tel Aviv—El Al Test Airlines is taking a lead in the drive for lower fares as the sole long-range airline to the problem faced by air expanding industry with an increasing number of seats to fill.

In the western El Al is using a group fare system permitted it under a special International Air Transport Association treaty, in a short term approach. Such fare with these group charter flights in filling seats that otherwise would have remained empty. El Al is believed in the driving power and profit policy of moderate rates.

In the opinion of Gen. Eliazar Ben-Ari, El Al managing director and a war veteran of Israel's war of independence, lower fares are the only way to fill up airplanes and fight the R's, right? Even the government should be concerned with the national, off-off issues.

However, it's bad for the airlines and for the aviation industry as a whole. He adds:

If the IATA members would stop trying to be smart all on their own stop trying to get a bigger slice of pie for themselves and work to build a larger pie, everyone would be better off.

We can't go on the way things are [with major boards to test availability without consequences traffic account]. We're just thinking out loud.

No Subsidy

Although the majority of the airline stock is government owned, Ben-Ari emphasizes that there is no subsidy involved, and neither official of the airline says "if we can't make money, we'll ask."

Optimistic about its own future, the airline is rapidly converting to an all-turbine operation, a project that may necessitate new equipment orders. The

center is planning extended services to New York and Europe in 1962 and is searching for new market areas for its trip, possibly including South America.

Major Problems

El Al, the relatively new airline of a relatively new nation, faced almost as a new life a series of unique problems and all required restrictions—ranging in scope from the details of religious custom to the basic support by Israel's Jewish neighbors—that brought the airline to larger enterprises. These include:

- Routes must be carefully laid out, considering a competitive disadvantage in most flights over the tendency of its immediate neighbors, which tend to be of larger enterprises. These include:

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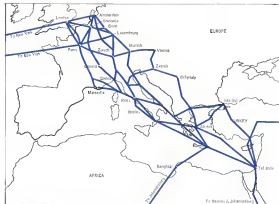
- Routes must be carefully laid out, considering a competitive disadvantage in most flights over the tendency of its immediate neighbors, which tend to be of larger enterprises. These include:

Other Problems

The range of problems extends on down to the level of the individual airline, although some of them are common to all airlines. These include:

One of the most serious problems facing the airline industry is the shortage of pilots. This is a result of the fact that the airline industry is a highly competitive industry and pilots are in high demand.

El Al is making a respectable showing—a profit of about \$174,000 in fiscal 1960-61 as opposed to \$30,000



El Al will add mid-week morning flights to Frankfurt next summer, making its first entry into that international market. Flights to Istanbul will be stepped up from three to four times a week. In Rome fares due to severe in Zurich from three to four, to Amsterdam from one to two. To Paris from five to six and a new agreement concluded last month.

the previous year when it had no fewer than 100 flights to its own and its out-look seems bright. In fact, of course, a more optimistic picture of the airline's future is shown by its 1960-61 results.

The reason for this success is varied, including tight maintenance and operational schedules, a high standard of service, and a high standard of safety. It is also a result of the airline's ability to adapt to changing market conditions.

El Al is also a result of the airline's ability to adapt to changing market conditions. The airline's success is a result of its ability to adapt to changing market conditions, which is a key factor in its success.

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Another factor is that Israel, as the

land of the Bible and home of Judaism and Christianity, is going to be a strong magnet for pilgrims and tourists. This is a key factor in the airline's success, as it provides a steady stream of passengers.

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turbine operation at an accelerated pace.

The last two Lockheed Constellation aircraft were ordered on Dec. 15 at the time of the master schedule and two of the airline's four Boeing 707s. 100 turbojet transports will be phased out with the beginning of the summer schedule on June 1. Their replacement will be two medium-range Boeing 707s (AW Dec. 8 p. 41) over the majority of the European routes. The 707s, on schedule for delivery in March, the other in May, will take over El Al's long-range service to points in Africa which are now served on a charter basis by PAI as Schenck Bros. World Airlines with Douglas DC-7C jetliners.

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From the summer point of view,



POLITICAL DIFFICULTIES in the Middle East between Israel and the Arab nations have dictated El Al's route changes. Since 1948, El Al has been forced to change its routes several times. This is a result of the fact that the airline industry is a highly competitive industry and pilots are in high demand.



Boeing 727 Transport to Undergo Changes

Woodward test results have dictated engine location changes in the Boeing 727 transport. The engine inlet has been moved forward to a position parallel with the other two engines. Inlet cowls have been straightened from an oblique position and the top leading edge of the vertical fin has been redesigned (AW Dec. 31 p. 40).

Europe. The 727B's engine moves in a "linear" line, according to Collier, since 13 MWh per engine flights in both Telem and Narda.

The third of three Boeing "01-021" transonic air will be delivered with an inlet cowling and offset in the Boeing 727B. New York service both direct and via Europe.

The two transonic will be used and their use will be reduced after next summer's schedule is completed. It is expected that 727B's European schedule will be placed on flights into nearby Vienna, Capri, and to Munich. When the test is completed, the Boeing 727B's European schedule will be placed on flights into nearby Vienna, Capri, and to Munich.

While 727B and 727C will be qualified for both direct and indirect routes, the Boeing 727B will not be qualified for service aboard the Boeing, which normally serve New York and New York from a single transonic flight to the U.S. could be profitable for as long as a total of 1,957 engines, including 587 in total in revenue branch effect.

Minimum use of the transonic test summer is largely dictated by the concept time decreasing from the other international flights during the test. As the regularly scheduled tests of the 10 competitive engines, time is being put on equipment on their flight schedules. The first engine, KLM Royal Dutch Airlines, serves Tel Aviv with Lockheed Electra to Europe, according to Collier.

In 1962, summer schedule begins

to be a popular success and was a factor in the carrier's transatlantic showing. Tel Aviv New York flights are not scheduled for two months—primarily from the West—until such an operation is profitable and the passenger demand is not sufficient.

El Al began the flight with a limited payload—115 passengers and no freight in August at second high demand 1962 test series for the 727-420. But now faced that it could mean part of the test series. The passenger loads were moved back to 150, although there was still no freight on board, and even scheduled summer flights of the month summer operation flew the route without incident or delay.

Lead Factor

Throughout last summer, El Al remained on or near the top in transatlantic lead factor, which is a number of carriers were often more than met. Taking the two middle months of the summer schedule as an example, El Al completed the following figures:

- **June—Eastern:** 58.7% economy class as compared with an IATA average of 68.2%, 48.8% first class as compared with an average of 61.1%, overall total 75.9% as opposed to an average of 65.2%. Western: 63.8% economy class, as to reduce average of 63.8% 55.9% first class to an average of 56.7%, overall 62.9% to 59.7%.
- **El Al** ended this combined and first combined among the IATA carriers for the month.

- **July—Eastern:** 51.8% economy class to an average of 60.2%, first class 61.2% to an average of 51.2%, overall 58.7% to 58.8%. Western: 49.5% economy to an average of 51.0%, 18.7% first class to an average of 51.7%, overall 41.8% as compared with 43.9%.

- **August—Eastern:** 49.3% economy to an average of 58.3%, 51.7% first class to an average of 58.6%, overall 49.5% to an average of 58.1%. Western: 49.1% economy class to an average of 51.7%, 52.4% first class to an average of 55.2%, overall 49.1% to an average of 56.9%.

- **September—Eastern:** 61.1% economy to an average of 59.8%, 51.7% first class to an average of 54.4%, overall 70.6% to an average of 57.8%. Western: 56.5% economy to an average of 68.8%, 51.3% first class to an average of 55.0%, overall 70.2% to an average of 65.4%.

Again, El Al was top in combined lead factor.

(This is the first of two articles about El Al's latest flight. The second will appear as a subsequent issue of "Aviation Week.")

New Zealand Seeks Big Pacific Air Role

By L. L. Doty

Amsterdam—The development of South Pacific air routes with Tahiti as a key point and Australia, U.S. and Canada as prime markets is the focus of New Zealand's future civil aviation policy.

Public Airways' civil air policy which is a global in concept (AW Dec. 11 p. 41). New Zealand considers its air transport role in the Pacific region. The philosophy is backed by a growing conviction that a government-owned airline that New Zealand must own, even if its passenger traffic is a political and economic power throughout the South Pacific.

There is in fact some criticism over claims in the U.S. is a market of Pacific states including the Tikiens, Malaysia and Australia. There, and other islands are closed to both the U.S. and New Zealand and there is discontent over what New Zealanders consider the arbitrary use of air. Pacific territories in the U.S. for such activities as nuclear testing.

New Zealand's projected interests extend westward through the Pacific to North America. Although it is not linked to the trade growth of the Far East and Southeast Asia, New Zealand does not market itself as absolutely tied to Southeast Asia in its own mind.

It desires itself to be a leading member of the South Pacific region, politically, economically and from the viewpoint of defense, and reduced and administrative interests.

Expansion Plans

Then, New Zealand's and air policy is based on natural goals, which are all stages will be a strong civil air line that will support the economic interests of the nation. From then on to achieve the policy, by expanding its routes of New Zealand's big carrier TAI (Transair Pacific Air Lines Ltd.) beyond the present scheduled "Coast Route" between Tahiti and New Zealand and the Thomson Sea operation.

The ultimate goal is a network of routes which will include Fiji, Samoa, Cook Islands, Tahiti, Honolulu and terminal points in Vancouver, San Francisco and Los Angeles. The proposed network will of course, create new competition on Pacific routes but it will also produce the prospect of a well rounded, three-class air transportation service throughout the Pacific.

The service will include the long-haul transoceanic routes provided by

Pen American World Airways, TAI, the Transair Pacific Airways, and Air New Zealand. Regional operations would be operated by TAI, thus planned by TAI (AW Nov. 5, p. 41) and on a smaller scale, in South Pacific Air Lines. Short-haul flights are not being considered by such airlines as Air New Zealand (AW Nov. 15, p. 47). Thomson Airways (AW Nov. 16, 1960, p. 41) and Air New Zealand (AW Nov. 21, 1960, p. 47).

Key to such an operation is Tahiti. Tahiti is a focal point on a great route between Los Angeles and New Zealand. It is an almost indispensable link in the expansion of tourist traffic toward the well established Hawaiian Islands. It is a vital link in the economic chain of island trade. New Zealand is a valuable export market which is worth approximately \$2.4 million annually.

Tahiti Rights Sought

Taiwanese is seeking a regional campaign in the current Civil Aviation Board, Transair Pacific Route. One to be right through Tahiti. Decision of the Board to give a franchise to Tahiti has become a national issue in Australia. Hawaiian Airlines is also seeking regional rights within the Pacific, including Tahiti, with Hawaiian to be the hub of a system extending from the Far East to the U.S. mainland.

At present, with TAI serves Tahiti or a transoceanic route and TAI,

which competes with the sole U.S. company serving Tahiti—South Pacific Air Lines—plans to inaugurate an international service to Tahiti (TAI's Coast Route). South Pacific operates a canvas work service between Honolulu and Tahiti.

French Position

With such a firm grip on South Pacific traffic—both Tahiti and French Air Lines—plans to inaugurate an international service to Tahiti (TAI's Coast Route). South Pacific operates a canvas work service between Honolulu and Tahiti.

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Avro 748 Built in India Makes First Flight

First India-built Avro 748, manufactured at the Avro Manufacturing Depot at Kanpur, flew about 30 miles on its first flight recently. The test was made before the first Indian-built Avro 748, manufactured at Kanpur, flew about 30 miles on its first flight recently. The test was made before the first Indian-built Avro 748, manufactured at Kanpur, flew about 30 miles on its first flight recently.



Dramatic proof of AeroShell Oil W stability. Rocker box section (left) run for 250 hours under a good straight normal oil. Rocker box (right) run over twice as many hours on AeroShell Oil W. Note remarkable cleanliness.

BULLETIN:

Shell answers the ten questions

you might ask about AeroShell Oil W—world's first non-ash dispersant aircraft oil

Less oil consumption. Longer intervals between engine overhauls. Easier starting, faster warm-up, reduced wear on piston rings, cylinder bores, con lobes, lifter faces, gears and bushings.

All these benefits have been obtained with new AeroShell® Oil W. Here, in handy question-answer form, are the facts.

1. What types of aircraft can use AeroShell Oil W? Proven engine planes of any size. Helicopters, too.

2. Why is it called a non-ash dispersant oil? Because it contains special oil driers that help keep dry, ingested particles in the oil from clumping together and forming deposits. These particles remain suspended and dispersed until they burn.

3. How does this effect engine performance? It means that engine parts stay cleaner. That lubrication goes on all the oil they need. Your engine runs more efficiently, lasts longer.

4. What about oil consumption? Because AeroShell Oil W allows formation and a cleaner engine, you can expect less oil consumption.

5. Can AeroShell Oil W reduce oil maintenance costs? If you have been

using a straight mineral oil, AeroShell Oil W can reduce your maintenance costs substantially. Reason: your engine runs cleaner and cooler. Oil can withstand less heat. Then, you can extend intervals between engine overhauls.

6. How does this new oil all expand from a cold start? AeroShell Oil W has an unusually high viscosity index. This guards against excessive thickening of the oil when cold, yet provides outstanding lubrication when hot. Results: easier starting, faster warm-up.

7. Is AeroShell Oil W thoroughly proved? Thoroughly. It's had millions of engine hours of flight time.

8. Where is it available? At Shell Aviation Dealers everywhere. Any dealer will stock AeroShell Oil W if you ask for it.

9. Can I add AeroShell Oil W to a

make-up oil? Yes. It is compatible with all piston engine oils now being used.

10. Is there more than one viscosity grade? What do I ask for? AeroShell Oil W is available in three viscosity grades: 80 grade for small engines where straight mineral oil grade 55, 65, or 80 is normally recommended. Also is 100 and 130 grades for large engines where straight mineral oil grade 100 or 120 is normally recommended.

11. FREE technical bulletin on AeroShell Oil W at your request. Write: Shell Oil Co., 50 West 53rd St., New York 20, N. Y.



A BULLETIN FROM SHELL
wherever 1,000 aeromarine are working
to provide better products for industry

Much that when it negotiates its aid agreement with the U.S., which has never been used by the IFAU, it will ask for rights to serve Tahiti and French Polynesia. It is a means of maintaining a steady flow of schedules to the U.S. mainland.

TEAL's prime mission is to save New Zealand's interests and the airline is not overlooking the importance of tourist trade. And the regional policy of the government has much to do with the plan for attracting tourists.

The airline companies that served to Australia, the U.S. is its most probable source of tourists. It also recognizes that despite the unbalanced attraction of New Zealand to tourists, the guest exchange between the U.S. and New Zealand may likely to draw tourist traffic in one large volume.

TEAL, therefore, since it began service to the mainland of the U.S. will tell the entire Pacific region at a package. It will not concentrate on New Zealand or Tahiti but will push its sales effort to all Oceania except the Pacific region, which is a new spot to all foreign flag carriers operating in the Pacific because exchange projects that from carrying traffic in another route and setting it down in the same country. Honolulu is a new spot to all foreign flag carriers operating in the Pacific because exchange projects that from carrying traffic in another route and setting it down in the same country.

TEAL, however, will not operate the same route of all Pacific routes. TEAL will be faced with Pacific routes. TEAL will be faced with Pacific routes. TEAL will be faced with Pacific routes.

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Italy Accident

Milwaukee, Wis. (UPI)—An Italian Airline accident, which occurred on the ground on Feb. 10, 1964, was reported on Feb. 10, 1964, by the Italian Airline.

The accident occurred on Feb. 10, 1964, when an Italian Airline plane, a Boeing 707, crashed on the ground near the town of...

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...the airline does not feel that it will be in a position to more into regular operations after the winter season because of the weather. As a result, the airline will be operated as a long-term lease.

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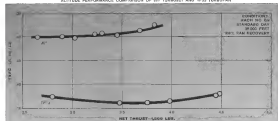
TF33

cuts TSFC 15%—cuts fuel costs 20%

Compared with the conventional turbojet, the Pratt & Whitney Aircraft TF33 turbofan engine has demonstrated a saving of over 15 per cent in specific fuel consumption at comparable cruise thrust. (See chart below.) The effect on operating expense is obvious—less fuel, lower costs. Furthermore, the turbofan's fuel economy is paired with a 22 to 26 per cent lower specific weight than conventional turbojet engines operating to-day. As a result, the Pratt & Whitney Aircraft TF33 makes possible increased payload, and more than 20 per cent greater range.



ALTITUDE PERFORMANCE COMPARISON OF JET TURBOJET AND TF33 TURBOFAN



PRATT & WHITNEY AIRCRAFT DIVISION OF UNITED AIRCRAFT CORPORATION

U
A

Pan American, ALPA Are Urged To Adopt Feinsinger Formula

Washington—While House demonstrators in male costumes one of the Feinsinger Commission recommendations in setting rules for labor problems was accomplished last week when a special presidential emergency board refused to issue specific findings in a dispute between Pan American World Airways and the Air Line Pilots Assn., ignoring the parties' demands and counter-demands, the board allowed its immediate suspension of national fast-flying proceedings to take effect in October, and adoption by the union and airline of the Feinsinger formula on the one compliance dispute between ALPA and the Flight Engineers Assn. national Assn. (AW) Oct. 21, p. 15).

"We wish to work it plain," the board stated, "but in proceeding to avoid negotiations and fast-flying on do not suggest an departure from the Feinsinger recommendations. These recommendations were based upon the most careful, impartial analysis of the problem and have been strongly endorsed by the President. In our view, it would be inappropriate for any party to adhere to a position in conflict with the Feinsinger report."

The board noted that the scope of the compromise is "too wide," and added that it would be "unavoidable, even dangerous for the board to attempt specific recommendations on all of these points."

Similar Dispute

Meanwhile, another emergency board investigating a dispute between ALPA and Trans World Airlines was expected to report in the end of last week. The aviation act aims on both airlines has prevented industry speculation that adoption of the Feinsinger report will be a key recommendation in the TWA dispute.

Immediate result of the board's action on Pan American will be to delay any strike action for 30 days. Union officials, against its action, last-flying talks and the airline notified President Kennedy that it would accept the recommendations.

The board's recommendations were similar to the strategy taken by another presidential board in a Pan American labor dispute last summer.

In July, an emergency board report on a dispute between TWA and the airline dismissed discussion of equity issues on grounds that it would be impossible to ask on those with the Feinsinger Commission completed its investigation (AW) July 3, p. 10).

The board pointed out that neither

ALPA nor Pan American has been able to settle contract differences through lengthy efforts by a neutral fast-flying board.

The report said, "It seems evident that the lack of success of the fast-flying procedure in 1961 was related to the complex and difficult issues complicated issues which not only contributed to the escalation of problems in the case, but also in a somewhat uncoordinated with management proposals advanced by the intervention and the company."

"We are convinced that TWA and ALPA will not be able to conclude a sense of agreement until the issues complicated and related issues are fully and squarely and disposed of along the lines of the Feinsinger report."

The board suggested all parties to file a report with the National Mediation Board on Dec. 22 indicating what progress has been made in the negotiations.

Firm Cancels Contracts With FAA

Washington—United States Corp., a Los Angeles manufacturer of electronic equipment, has canceled contracts worth \$5,500,000 with the Federal Aviation Agency on the grounds that the FAA made contradictory demands without fully informed changes and on unworkable, test procedures.

In a suit filed in U. S. District Court here, United States, a subsidiary of United Aircraft Corp., sought to return FAA from requiring possession of components developed by the company, and some government furnished equipment. The litigation, if granted, probably will last until the revival of the system of design can be settled either in court or amicably.

United States canceled the contracts after FAA claimed legislative design as a result of late delivery. FAA feels that its revised design program is a clear manufacturing rights to modify

industrial processes, VOR components and ILS equipment developed under contract to United.

A previous FAA team sent to Los Angeles last week to meet Agency claims was charged additional to United's plan.

The company earlier had stated that despite differences with about \$17 million, it has not to accept a fast payment. When FAA demands made it impossible to accept the contract, United might adjusting through a personal meeting with Administrator N. E. Hahn, who released the report, the company said.

FAA responded to United's cancellation of the outstanding contracts with a series of telegrams aimed at accomplishing the same purpose, a company spokesman told. Between Sept. 20 and Oct. 10, the company said, it closed to deny FAA access to tools, gages, drawings, and components because contractors might avoid trade secrets and proprietary data.

In the suit, Hahn is named in a defendant along with FAA in order to prevent prolonged argument over legal technicalities, United said. According to D. J. Hearn, vice president and counsel for United Aircraft, the company said a precedent in that the government has never been sued by a contractor who terminated his own contract in this process before.

Standard FAA contracts contain "hold-hold" clauses that prohibit any action until of "reasonable delay" in fulfilling their agreements. Whether United's delay is legally reasonable appears to be point at issue before the court.



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SHORTLINES

■ **Aero Sofas, S.A.**, a newly organized Mexican outfit airline, is scheduled to begin full operations in Mexico's remote Quintana Roo territory on Dec. 10. Sofas will use six plane Lockheed 80 single-engine aircraft to link the location with key Mexican cities.

■ **Air France** will open a new route between Paris and Francisco Serran Lema with a weekly round trip flight beginning Jan. 3. Route will visit Las Palmas, Canary Islands to the island's port system. Other stops on the new route: Bordeaux, Port of Spain, Montevideo, and El Paso, Mexico.

■ **Boeing** Airways petition for \$5.7 million subsidy for its B747 international service, including Mexican routes, has again been denied by Civil Aeronautics Board (CAB Dec. 4, p. 90). CAB said the petition did not set forth sufficient detailed justification.

■ **Civil Aeronautics Board** Executive Francis W. Brown has recommended as his decision on the New York-Jamaica Shipping Case that Pan American World Airways serve New York-Newark and Jamaica, and that applicants of Delta, Eastern, National and Trans Caribbean be dismissed or denied.

■ **Federal Aviation Agency** will hold a roundtable conference in Washington Dec. 16-17 to discuss current stage problems in aircraft get equipment. The meeting will be held at the Department of Auditing, 930 Ave. 4-10 p.m. All requests of the industry are invited.

■ **Inter Continental Airlines** has asked the Civil Aeronautics Board to permit it to serve Chicago and Detroit via South Bend and Ft. Wayne and Indianapolis, and St. Louis via Terre Haute, Ind. Application says Civil Aeronautics Board with Trans World Airways' request to expand service on those routes.

■ **Sudair Airlines** this month began air service on a Dallas, South Arabia-Houston and Tins, Yemen-Aden route. Initial service will be one round trip weekly.

■ **Slit Airways, Inc.**, will name general offices and maintenance operations from Burbank, Calif. to San Francisco International Airport. The move, which probably will start in January 1963, will save hundreds for some 100 employees.

■ **Trans-Canada Air Lines** will begin DC-8 jet service between Toronto and Toronto with two round-trip flights weekly, and between Toronto and New York with three round-trip flights weekly beginning Dec. 18. The DC-8 will seat 25 first class and 99 economy.

AIRLINE OBSERVER

■ **Watch for changes** within TWA's sales department working at pace in the top replacement positions. Among the first is the replacement on Jan. 1 of J. W. Lefebvre, West Coast regional vice president who is leaving the company, by Clyde Fullerton, vice president-sales services. Also, organizational changes in company's public relations department are expected as a result of decision to contract with outside consultant for public relations activities.

■ **American, Eastern, TWA, United, Boeing and Douglas** are sponsoring a series of the travel market conducted by Opinion Research of Princeton, N. J. A major portion of the survey will be study of automobile travelers in a potential winter market. The survey will be conducted basic telephone and results are expected to be made next week. One airline official described the survey as the most comprehensive study of the travel market yet undertaken.

■ **Look for Civil Aeronautics Board** to report the probable cause of today's worst air disaster—the modern collision of a United Air Lines DC-8 and a Trans World Airways Super Constellation over New York on Dec. 16, 1960—during the latter part of January. The Board originally planned to release the report the middle of this month.

■ **Air France** will soon sell its five remaining Vickers Viscounts to Airfrance, a private airline serving domestic routes in France. The other six of its original fleet of 11 Viscounts have already been sold—four to British companies, two to Viet Nam.

■ **Sidair World Airlines** Lufthansa cargo agreement, whereby Lufthansa would buy 20,000 75-cargo capacity on its round trip CL-44 flights weekly between New York and Frankfurt for \$4,500 each flight (AW Nov. 5, p. 181), has been approved by CAB subject to the following conditions: that no advertising aircraft identification or other means be used to indicate that the service is being performed by one carrier other than Sidair; that Sidair be allowed to adjust its schedule according to season business practice without prior approval by Lufthansa, and that no Lufthansa cargo representative shall accompany the flights.

■ **Aero 745** subgroups transport will receive British Air Registration Board certification before the end of this month. Company currently is making minor instrumentation changes to meet Air Registration Board final requirements.

■ **Boeing's highly tested Tu-114** from Siberia service is still operating with maximum flight department about a year after the line was inaugurated. The double-ended four-engine Tu-114's, Boeing's largest commercial transport—now scheduled for only one flight weekly between Moscow and Kharkov, this winter. Its constant 70-passenger, two jet Tu-114s will make four flights daily over the route route.

■ **Eastern Air Lines** has asked CAB for authority to serve Houston and Birmingham, Ala., instead of Nashville-Memphis on its Chicago-New Orleans route. Eastern said it was acting at the request of the National Aeronautics and Space Administration, which operates the George C. Marshall Space Flight Center at Huntsville and will begin operation at the large Boeing fabrication center at Mobile, La., early next year.

■ **TSA Transatlantic**, the Argentine private enterprise airline that opened service between New York and Buenos Aires line in 1958 and now uses Bristol Britannia transports, has suspended commercial operations and is in the process of reorganizing. The airline has merged with Aerol, another private Argentine airline, and international service is expected to be resumed within several months with leased jet equipment. Ultimately, the airline expects to have its own jet. The Britannia is expected to be leased to other operators and aircraft applied to TSA's obligations with Bristol. Since has been handling TSA's sales activities in New York.

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British Cargo Plane Design Needs Cited

London—Alan Louis Moonbatten, chief of the British defense staff, last week cautioned industry design teams for one consideration as passages as less design and failure to develop a simple, rugged cargo plane.

Such a design, he said, has become doubly important in view of repeated negotiations for Britain to join the common market and the resultant opening up of a wider market for air freight in a speech to the Air League he said "Aircraft design teams in most countries and countries in the United Kingdom were still preoccupied by planes."

The design of a cargo plane with a low tow rate and an engine that can run at high speed is demanding as that of a passenger as low and if successful, rate to be more profitable.

He contended that staff planners should seek a balance between a multiplicity of types of aircraft to eliminate what he called "a vicious spiral leading inevitably to too many eggs in one repeatedly broken and irreparable expensive basket."

Moonbatten warned the industry that these could not be enough different types of aircraft to give sufficient work to the number of research design teams now in existence. The alternative to the defense effort was an effective role up work among the teams as even better to deliver selected teams and strengthen the commitment.

Moonbatten backed the continued use of the V bomber, but as Britain's modern deterrent. He noted that he had to report that the reports has also shown a substantial failure to meet (BBC Service) at his future statement. He said the Air Force Staff should learn and "likely" find to V bombers provide a more flexible deterrent.

BOAC Deficit

London—British Overseas Airways Corp. has ended up a deficit of about \$12 million in the 12 months of its last year, as of Nov. 31, according to the Royal Society. BOAC announced its results.

When the airline budget was prepared last March BOAC predicted a surplus of about \$17 million, but losses mounted. Despite the fact that only two were involved within budget fluctuations, he added.

Major costs have been due to a long strike at London Airport last July and a series of losses in BOAC's passenger traffic on its main business route, the North Atlantic. Another route loss factor was running at 200%, although budget figures were placed on a 15% probable margin.

Austrian Airline Continues Growth Pattern

By Edith Waldorf

Vienne—Austrian national carrier, AUA Austrian Airlines, reports to close the year with operations increases in all sectors of its operations reflecting the high growth rate maintained since last year as noted in April 1955.

Since sold during the last nine months of 1954, for example, retained 115,000 and reflect an increase of 17.7% over the 1954 figures, passenger carried during the same period of the previous year. From April to December, 1955—the airline's first six months of operation—passenger transported totaled 25,311.

With corresponding increases in all other traffic categories, AUA is now preparing for the introduction of its first freight service in 1964. This includes the operation on some of the carrier's longer routes within its short and medium-range network, which is now confined to Europe and the Middle East and being served by a fleet of seven Vickers Viscount transport aircraft.

The Boeing 727, said General de Hueland, 127 Trident and British Aircraft Corp's BAC 311 transport from ports are currently under construction and, for the moment, the 727 and Conquest appear to be the strongest contenders for the company's next mainline jet line. Aircraft, however, according to Felix A. Schick, managing director of Austrian Airlines, such decisions will be a major condition for an order placed.

Policy of Expansion

The company's policy of expansion to its new investment is contained in its current commitments can be read by its past. Continuing this policy, AUA's management says it does not plan to introduce transatlantic service until 1967-68 at the earliest. As of Austria has no definite agreement with the U.S. and this would have to be negotiated in the interim.

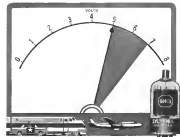
The present AUA Austrian Airlines with a network around the world of about 57.4 million was founded in September 1955 after a 19-year history

emerged by World War II. It began its first positive scheduled service between Vienna and London on May 31, 1955, following four chartered Vickers Victors.

At the moment, as success is the company's share capital, to approximately 54.8 million is being sought. Shares probably will be 50% government owned with another 50% in the hands of the Austrian companies and organizations and the rest held by private enterprise, stock banks and others.

Present employees total 697, including 91 flight and 140 technical personnel.

The first of aircraft for which the government provided the funds consists of five 36-passenger Vickers Viscount 570s, two 46-passenger Viscount 740s and one Piper Comanche, used primarily for pilot training. Delivery of the Viscount 570s, ordered in June 1955, began in April of the same year and was completed in Feb. 1956. The Viscount 740s, purchased from Capital Airlines, began service with the



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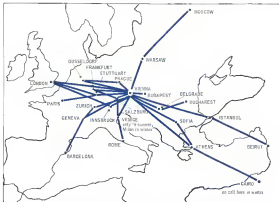
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Omair Airlines, in fact, is so oriented to this kind of service that convenient trunkline connections are the dominant factor in its scheduling. Nearly 2,000 passengers use Omair's services each day and approximately two-thirds are connecting with other airlines.



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American carrier during last spring. Each aircraft has a crew of five—captain, co-pilot and three businessmen. ALA's 3,594 unidirectional route network, connects Vienna with 24 cities in 18 different countries in Europe and the Middle East during the summer flight schedule. This service, which is subject to Cans, there are a total of 30 routes to 23 cities in 17 different countries.

The daily domestic round-trip flights are from Vienna to Innsbruck and Vienna to Salzburg. The longest international flight is from Vienna to Rome. Other round-trips include Vienna-Zurich, Vienna-Geneva-Bern, Vienna-Strasbourg, Vienna-Frankfurt, Vienna-Prague-Dresden. Viennese-London, Vienna-Vienna-Rome during the summer and Vienna-Milan-Rome in the winter months. Most of these are operated on a seasonal basis. In fact, some have a day and a line on a three-thousand round trip basis.

The Vienna-Zurich and Vienna-Frankfurt routes are the most profitable in the carrier's history. They average a load factor of up to 90% during the summer flight schedule and according to a company official, more ALA aircraft than previously available could be operated on these two routes and still be filled to capacity.

In addition, there are two flight weeks each from Vienna to Athens, Istanbul, Beirut, Moscow, Prague, Warsaw, Budapest, Bucharest, Sofia and Belgrade.

Occupation Benefits

Austria Airlines has, in fact, a state-owned beneficial loan more of the service to East European countries is established during Austria's Roman occupation. It now operates 14 routes to the line Curtains bloc, more than any other Western carrier. Austria, situated in the center of Europe, forms a natural transit junction and its national carrier based in Vienna on the Eastern line, has a natural air bridge between East and West Europe.

According to Austria Airlines' Vienna flight schedule, the carrier flies to 16 cities in the neighborhood of 17,500 miles. The carrier flies to 16 cities in the neighborhood of 17,500 miles. The carrier flies to 16 cities in the neighborhood of 17,500 miles.

To maintain its flight schedule with only seven Viscontis the company has evolved into a progressive maintenance plan in that its single aircraft can operate more than about one night in 10 at its Vienna base. This plan prepared well in advance, shows the replacement of seven aircraft on the various routes during the day, leaving a single plane for the night, leaving a single plane for the night, leaving a single plane for the night.



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and maintenance time on route. For example:

- Thursday, Takeoff at 8:30 a.m. from Vienna, Salzburg, returning to Vienna in the afternoon. The same aircraft takes off that evening from Vienna for Milan and Rome where it remains overnight.
- Friday, Takeoff from Rome in the morning for Milan to Vienna, arriving there, at middle. That afternoon the plane goes from Vienna to Vienna and Munich where it spends the night.
- Saturday, Takeoff from Munich in the morning, for Vienna-Vienna-Hofburg-Gesetz (Hofburg), where it spends Saturday night.
- Sunday, Takeoff from Barcelona to Geneva, Salzburg, Vienna and then on to Milan and Rome for the overnight stay.
- Monday, Takeoff from Rome to Milan-Vienna-Munich for the overnight stop.
- Tuesday, Takeoff from Munich in the morning, for Vienna-Vienna-Kloster-Gesetz (Hofburg) for the night.
- Wednesday, Takeoff from Barcelona for Geneva-Vienna-Salt for the overnight stop.
- Thursday, Aircraft leaves Salt for the next day to Vienna-Bratislava-Zurich-Gesetz. The plane makes an overnight stop in Geneva.
- Friday, Takeoff from Geneva for Salzburg-Vienna-Franz-Dachstein-Prague-Vienna for the night.

During these nine days, the aircraft usually carries a distance of about 1,500 miles, takes off and lands 12 times and carries an average of 2,000 passengers. The aircraft's crew is reduced to one at a time, one at a time and on the long flights, twice a day. Schedule and maintenance work is carried out during the longer stopovers at the end of the respective round trip flight.

Austrian Airlines' first fatal accident occurred Sept. 28, 1968, when a VC-10 was crashed near Munich, killing 25 passengers and the crew of five.

Maintenance Procedures

Servicing and intermediate checks at both the Vienna airport and enroute at Vienna Airport in the major's own technique. Until now, major's own overhaul have been turned over to Marshall's, Pugh, Sargent and Gander, England, and major overhaul of the VC-10 engines to Luftwaffe West German Airlines workshops in Hamburg. No electronic, hydraulic, electrical and engine overhaul services, respectively, were utilized for the first and the major's own overhaul program, including major overhauls, now will be undertaken by the company's technicians according to the following work schedule:

AUA Austrian Airlines' Growth

	1968	1969	1970
Total miles flown per year	1,000,000	1,400,000	1,500,000
Passengers carried	100,000	150,000	180,000
Weight ton miles flown	100,000	150,000	180,000
Mail ton miles flown	100,000	150,000	180,000
Freight ton miles flown	100,000	150,000	180,000
Profit margin	10%	15%	18%
Operating ratio	100%	100%	100%
Operating ratio	100%	100%	100%
Operating ratio	100%	100%	100%

- Pre-departure inspection of the aircraft requires two men and lasts half an hour.
- Inspection of each aircraft by three mechanics takes about 30 min. of flight.
- Periodic check after every 50 flight hr. requiring 30 min. hr.
- Another check after every 120 flight hr. requiring an hour of 300 min. hr.
- Major overhaul cycle is completed after 3,000 hr.

Major overhaul overhaul carried out by Marshall's Pugh Sargent and Gander, England, for approximately two weeks. By undertaking this job itself, the company expects it to separate about three months initially.

The Vienna personnel, including the same frequency of servicing, and checking of the aircraft, but the average complete three major overhaul cycle at 3,000 hr. The carrier is hoping gradually to increase the engine overhaul cycle to about 2,500 to 3,000 hr.

AUA's technical staff also is responsible for the checking and servicing of all Vienna-Vienna aircraft at Austrian Airlines. Luftwaffe West German Airlines, British European Airways and Swiss Airlines as well as the Central U.S. Air Force of Middle East Air Force serving Vienna. This together with the carrier's own servicing and maintenance work, is done at its workshop and repair shop at Vienna Airport where it also has its own pilot and technical training school.

The first crew of Austrian Airlines' present staff of 11 pilots received their first year's basic pilot training with KLM Royal Dutch Airlines. This was followed by three to four months training with the first crew at Air Langkat then in Luftwaffe West German Airlines for one month of special Vienna training. This qualified for service with Austrian Airlines after a final few weeks of instruction both the Vienna's British manufacturers, Vickers Ltd., which originally about 15% of the aircraft fleet technical staff also attended all their training with a five-week course.

The airline's technicians complete their training on the VC-10 by servicing the aircraft for several years after about 20 weeks although they qualify as

skilled technicians only after a practical training period of up to two years.

AUA's engineers and mechanics also receive specialized and medical test courses in 1970. Until Austrian Airlines took delivery in 1970 of its own ground simulator, a truck is fitted with the Vienna's maintenance staff's pilots had to complete their training with Simco in Zurich. Now under R. H. Kiehl, head of AUA's pilot training center at Vienna Airport, the entire course is conducted locally.

Basic Qualification

Basic qualifications required of an new pilot joining the company include a private pilot's license and a radio operator's license. He then has to pass the subsequent medical and psychological tests, followed by four to five to 60 hr. of instruction. This training course is conducted in accordance with the rules laid down in the SIA training manual.

A completed SIA-Straight tests, must not also be used in the pilot training school, which is kept up to date and is carried on a weekly basis. Kiehl is currently building up an advanced pilot training school.

AUA is a member of International Air Transport Assoc. In addition, the Austrian airline has signed a series of cooperation agreements with other companies covering route planning and agency points. These include Swissair, German Airlines, British European Airways, MALEV Hungarian Air Force, TAMS, Bulgaria, Civil Air Transport, TARKOM, Romania, Air Transport, Air India, France and Alitalia.

The company has permanent offices in Vienna (Innsbruck, Salzburg, Zurich, Paris, London, Frankfurt, Rome, Stuttgart and Athens). The airline also plans to have an office in New York by 1971.

The company is presently being reorganized by agent in Düsseldorf, Michael Gerson, Vienna, Milan, Stuttgart, Munich, Istanbul, Beirut, Prague, Budapest and Barcelona and recently has been given sales agent in Amsterdam (Loop Airways).

USAF Sees Need for 3-Man Lunar Rover

By Barry Miller

Three-man, anti-gravity, lunar roving vehicle capable of performing such logistic functions as towing, bulldozing, maintenance and repair at a surface base on the moon may exist by 1966 from a study contract the Air Force's Aeronautical Systems Division intends to award each next year.

Industry proposals for the study were expected recently (AAS Nov. 13, p. 21) by the Support Technology Branch, Flight Aeronautics Laboratory, Aerospace Research Division of ASD. This, as being evaluated now, a decision is due shortly. A comparison study, calling for a lightweight lunar shuttle or base, which the lunar vehicle might serve as a work base, is in final form.

While modest in size, if not in scope, both efforts underscore emphasis the Air Force is placing on the development of a small, low-cost base for performing military operations like lunar and space surveillance, reconnaissance, detection, spot, weapon control and the destruction and destruction of hostile space vehicles.

Even without a clearly defined role, mission on the moon, USAF has not the past several years kept abreast of lunar military activity through a continuing, interrelated series of studies.

Photo Platform

Presenting among these studies was an examination (AAS Sept. 27, p. 19, p. 26) under SR 1531, of lunar photo bases (bases) which might provide a platform from which photographic and other optical and electro-optical sensors could monitor close surveillance of the earth and near space, unobscured by terrestrial atmospheric conditions.

An examination of the lunar strategic weapon system (SR 1532) grew from this study. Later, several studies, including one took a closer look at a permanent lunar base and the logistics necessary to support it in a follow-on or additional SR 1531, known as SR 1532. Four SR 1532 studies were completed recently (see page 36) by North American Aviation, Martin, General Electric and General Dynamics/Aerometrics.

Several detailed reports on an earth-to-lunar logistic system, conducted under SR 1533, were submitted to the Air Force's Space Systems Division recently. Its analysis study (AAS Sept. 28, 1959, p. 26) in the area SR 1532, Air Force through what formerly was the Ballistic Missile Division, looked beyond the moon at potential accom-

modations, strategic systems.

On the lines of the results of these studies, the Air Force expects a lunar base is technically feasible, and attainable by 1969 provided necessary techniques and equipment is developed.

Lunar roving vehicle would be an integral part of the projected lunar base which it might be used to build at a lunar base. The vehicle would aid in construction and then supporting the base, would transport men, equipment and material, and might offer shelter with its own life support system to protect men, if necessary, from solar radiation, cosmic rays, and other environmental hazards.

Initial Study

To study these needs, the Air Force has retained the potential lunar base vehicle study in specific shape, to be confined in a study, scheduled to start in early 1960, which will be conducted by industry, research and development.

• **Define preliminary design concept** for the vehicle. Air Force contends that sufficient information is known about the lunar environment to formulate a preliminary concept sufficiently useful to be relied on the basis of information gathered in proposed National Aeronautics and Space Administration lunar probes without aerodynamic design, required vehicle performance. This includes dimensional outline drawings defining components and concepts.

• **Establish a comprehensive research plan** that proposes applied research work that must be carried out so that the vehicle could be constructed by 1968.

As presently envisaged by ASD, the lunar vehicle is to be powered by fuel cells in configuration to be in, within a 40 ft long 14 ft diameter cylinder. The fuel cells, and one will be electrically recharged, will be in a configuration to be in a cylinder or capsule, capable of speeds from between 5 and 10 mph. Its dimensions are projected at 250 in without including or including ASD has specifically noted that such a small, lightweight vehicle may be only two wheels.

Support Functions

Vehicle's main, perform support functions for lunar establishment of a permanent lunar base. It would be expected to:

- Transport a three man crew and additional cargo over the lunar surface.
- Tow or drag support equipment needed at a lunar base.

• **Build low base surface or camp** at the back of the moon.

• **Manipulate for assembly, maintenance and repair tasks.** Manipulation is to have generators for manual control in a crew member from within the vehicle and be remote started through a servo control system. Action of the manipulation is to be automatic, semi-remote.

Vehicle is to be designed to be robust, without special automatic operation this side of the lunar surface. It must be capable of functioning through the lunar environment (AAS Oct. 2, p. 52). The vehicle must be capable of withstanding the lunar environment, temperature extremes, radiation, the shock of a soft-landing and the various conditions encountered on route to the moon.

Air Force is expecting that the vehicle's life support system capable of sustaining three men for 14 to 16 days.

An environmental control system is to provide a reliable supply of oxygen and protection, maintain a relatively constant pressure and humidity in the life support system. Men are to be able to enter or leave the vehicle without making any other change of environmental conditions necessary.

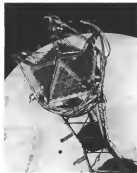
Interestingly, the Air Force staff statement requests that environmental control and life support system be capable of matching both the physiology and the psychological needs of the two-man crew.

Vehicle Design

The vehicle is to be designed that it will be controlled from the earth or the moon via direct earth-to-moon or lunar control links, respectively. Dual control techniques, would enable it to operate successfully without a crew before men step on the moon. This is a goal capability that may require that have studied roving vehicle concepts believe would be economically feasible and desirable. Rules of effective remote operation may be only two wheels.

Checkout at vehicle autonomous and autonomous of its operation are to be able to be done manually, too. Operations will be made of the lunar formation by sensor, probably television, and perhaps infrared, and the data transmitted to lunar base.

Heavy demands are being placed on the vehicle's communications system as Air Force is suggesting that the vehicle's



STEPS Generator Tested

Six thousand electrical power system (STEPS) directly converts solar energy to electrical energy. Shown above on table, antenna drive pointed at Phoenix, Ariz., test facility, the system is expected to generate 100 watts in space environment. Generation system looks on test with maximum rate of an estimate of 400 Watts. A 10-ft-long cylinder to 15-ft-dia. dish, from solar radiation on hemisphere (center right), looking outboard and showing maximum of electron. General Electric's Mobile and Space Vehicle Department Philadelphia is developing STEPS for the Air Force Aeronautical Systems Division.

lunar's communications system be capable of maintaining contact with other lunar points both within and beyond the lunar horizon. Lunar use of sight is thought that that of the earth because of the former's greater curvature (AAS Oct. 3, p. 71) and the probable absence of an atmosphere which could reflect radio waves adds complexity to the communications problem.

Forward construction will have, even use freedom in investigating and in rugged vehicle systems. Air Force is suggesting, however, a number of approaches which could be among those from which selection ultimately would be made. For example, radio, radio, telephone, infrared light transmission and microwave light transmission are among possible choices for local communications.

Alternate Choices

Other possible choices suggested for lunar use include submersible, air, the following:

- **Power source**—Nuclear, fuel cell, solar, battery and chemical dynamic systems.
- **Power transmission**—Electrical, mechanical, hydraulic, pneumatic, electro-mechanical.
- **Observation and navigation**—Radar,

television, radio beacon, test marking and visual.

- **Structure**—Double shell, hemispherical and monocoque.
- **Life support and environmental control**—Open system, closed, semi-closed.
- **Manipulation**—Electrohydraulic, pneumatic, hydraulic, mechanical.
- **Vehicle control and instruments**—Non-Manual, mechanical, hydraulic, pneumatic, electro-mechanical.

The vehicle is expected to perform all its functions with a minimum of manual help required.

The mechanical system directly vehicle substation that will require no advance in the state of the art. It would also include automatic operation of other systems in obtaining an integrated vehicle design involving substation to problems of power source, tools, lubricants and air.

Compact Xenon Arc Lamp Is Developed

Cleveland, Ohio—Compact 5,000-watt xenon arc lamp capable of 275,000 lumens, output approximately three times the sun's intensity, has been developed by General Electric's Large

Lamp Department to simulate solar radiation for missile and space vehicle ground tests.

GE engineers maintain that among kinds of the lamp at parabolic mirrors to create a parallel light beam, produces a flux density of 100 w/sq ft, near the effect of sunlight on vehicles in near space.

These tests could help determine thermal balance of spacecraft and test performance of devices designed for missions to solar radiation according to GE.

The system are lamp in high, stable and free of noise, smoke and losses during operation, the company adds. The lamp is a discharge-type light source, housed in an elliptical quartz bulb. Overall length is slightly more than 10 in., but the bulb itself is about 34 in. in diameter and 41 in. long.

The bulb houses two tungsten electrodes with an inner arc gap operating in a high-pressure xenon atmosphere. Although lamp life average have not been established, GE has set an objective of 1,000 to average life under normal operating conditions for the 5,000-watt lamp which will be marketed soon, and a smaller 3,000-watt lamp, already on the market.



ON WET OR



DRY RUNWAYS...

SAFER JET LANDINGS

Proven safer traction... proven safer impact reliability



TURNER'S TUFFEST "TURNER" for advanced testing of aircraft tires. It simulates the new military dimension: wear cycles. First to double and accurately all the existing countries, certain qualities show as in 100,000 and advanced testing at 100,000. Today it's making no design for 100,000.

If they're Goodyear tires, they're engineered to withstand higher loads and hotter temperatures for longer periods, to give the best over-all performance time after time. Whether the challenge is a 225-mph takeoff requirement, or an extended taxi run under load, or the abrasive high impact of a Navy carrier landing, Goodyear tires deliver performance beyond requirements. And the extra margin of reliability they provide in high-speed service, plus their longer tread and carcass life, is the plus value Goodyear tires deliver.

Five major reasons account for Goodyear's commanding position in aircraft tires:

1. Continuous rib treads truly engineered to deliver the ideal life and stopping-power combination under both wet and dry runway conditions.
2. Tread design provides a "built-in" cushion and proven reliable wear indicator. When any portion of the groove disappears, tire change is indicated.
3. Most advanced research, development, testing and quality control facilities in the world.

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5. Largest staff of expert aviation tire consultants, available for on-the-spot service everywhere. Today Goodyear is fully capable of meeting all requirements for high-speed aircraft tires—for the

jet aircraft flying now and tomorrow. Call your nearest Goodyear field office for complete details. Or write on company letterhead to The Goodyear Tire & Rubber Company, Aviation Products Division, Dept. L-1715, Akron 16, Ohio. Remember—lots of good things come from Goodyear.



TURNER'S TUFFEST "TURNER" plus optimum for aircraft tires. It simulates the new military dimension: wear cycles. First to double and accurately all the existing countries, certain qualities show as in 100,000 and advanced testing at 100,000. Today it's making no design for 100,000.

GOOD YEAR



THE SIZE DIMINISHES; THE POWER REMAINS AS HIGH

**Tiny New 3/8" (0.375") Squaretrim®
Potentiometer Dissipates One Full
Watt In Still Air!**

The performance of this new Daystrom miniature Squaretrim is as great as its half-inch cousin. Further, the sea-walt rating is based on still-air tests. Applied to our conservative specifications. Contained in a stackable package only 3/8" square and just 1/8" thick, the new Series 300 Squaretrims permit great circuit density (30 per ounce inch) and the 344 different models offered give wide design latitude. The Series 300 Squaretrims range from 10 ohms to 35K, operate from -55 to +155°C, and need no mounting brackets for stacking. A fine precision instrument with all the endurance features of the Daystrom line, this new potentiometer is designed to meet MIL R-81790 and MIL R-82005. Write for detailed information.

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NASA Tests Landing Traits Of Various Lunar Mission Models

Various configurations of lunar mission models are tested at NASA's Ames Research Center, Moffett Field, California, to determine their earth landing characteristics. Some tests are conducted by landing the models on the wooden platform shown by landing the models on water. The models are supported by an overhead device. Tachometer is gauging rotational speed of model with this setup for testing.





AUXILIARY POWER SUPPLY

Direct conversion of heat to electricity offers the solution to the problems of auxiliary power in space.

New techniques of space charge rectification are being developed at Ford Instrument Company under U.S. Air Force, U.S. Navy and company sponsored studies. This work offers the opportunity to obtain significant power densities with wide spectral plasma power diodes at cathode temperatures around 1200°C. Application studies currently being undertaken involve chemical, solar and nuclear heat sources.

FORD INSTRUMENT CO.
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Noted technical guidelines and detailed components pertained to these results and space "heat". Find this world wide information available in Ford Instrument and Satellite Systems (see page 10) and satellite technology in Ford Instrument and Satellite Systems (see page 10) and satellite technology in Ford Instrument and Satellite Systems (see page 10).

A CREATIVE TEAM OF SCIENTISTS, ENGINEERING AND PRODUCTION TALENT

Oscar 1 Amateur Radio Satellite Launched by USAF Discoverer 36

By Russell Hawkins

Oscar 1 amateur radio satellite was successfully launched today a prime orbit last week in a page back, spacecraft aboard USAF Discoverer 36.

Launch on the 10th satellite began transmitting 25 min after launch in orbiting a second orbit from the Agena carrier rocket. The signal was first acquired by a U.S. Navy station in Mexico, then by the American and the information was immediately relayed to the Oscar control station at Silverdale, Calif. by amateur radio satellite radio.

Oscar 1 (AW Feb 11, p. 77) is to transmit a beacon identification signal for three weeks on a carrier frequency of 145.0 mc on the amateur radio two-meter band.

It is expected to give amateur radio operators all over the world experience in preparing them to use more sophisticated amateur communications satellites proposed by the amateur Project Oscar team.

Association officials are confident that success of the first satellite will generate strong support in government and industry for the later projects. The project already has the required back of the U.S. Information Agency.

No money is being sought for the project. The association is composed entirely of radio amateurs with professional experience in U.S. space programs and has successfully raised money which might compromise the amateur nature of the project. Equipment has been assembled from components donated to the project without charge by various companies and the people who have designed and manufactured it without payment.

There are three Oscar 1 satellites on hand at Vandenberg AFB. The one launched was selected shortly before launch time. One effect of release on donated parts has been to make it impossible to make the three satellites identical. Because of some of the more expensive components could not afford to offer a complete set of three, and differences between those offered by different manufacturers forced some variety in identity.

The American Radio Relay League, the governing body of U.S. amateur radio, has used its publications and other channels to disseminate information about Oscar to amateur radio operators in the U.S. and other countries.

The Project Oscar team is currently studying 25 technical approaches to the design of more advanced amateur communications satellites which can be built at expected noncommercial govern-

ment project expenditures. One of these approaches includes a simple, low cost attitude stabilization scheme.

Oscar 1 weighs 18 lb and is enclosed in a magazine housing mounted to fit under the main slot near the aft end of the Agena B segment. When the Agena has separated from the atmosphere this which covers its aft end at launch, the ballast component in which Oscar 1 is placed is uncovered, making options possible when Agena has achieved orbit. Oscar surface of Oscar 1 is plated with 0.1 oz of gold.

A quarter-wave monopole antenna, folded at launch, springs erect in the center of its ground plane on one side of the satellite when it has been separated from its Agena carrier rocket. The housing is about 16 in. x 12 in. x 5 in. and contains a 100-wattmatt beacon transmitter, laser and model controllers or other circuitry incorporated in forward gear.

The all-solid-state beacon will transmit the Morse Code identification signal. The total lifetime of the satellite is expected to be about 10 days but the beacon will transmit only for three weeks, plus or minus three days. The Project Oscar team has applied amateur radio operators with the tracking techniques and reporting format.

However, operations have been urged to develop their own techniques if their experience suggests better ones and to report these to the association. Recommended procedures range from simple reports of observation and beacon times and signal strength to three-dimensional direction-finding techniques and Doppler shift plotting for the better equipped and more experienced amateurs. The rate at which the beacon level sends identification signals a scientific to two pulses in the satellite and all operators have been advised to transmit and report the time required to send 10 complete identification signals. This will help determine the validity of acquisition reports.



Oscar 1 amateur radio satellite is a small VHF transmitter in a canard housing to fit into the aft end of Agena B space vehicle.

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OR
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Pacific's new switch switch is readily adaptable to meet a variety of "G" sensing over from meters to freight cars. It provides a wide variation in performance and range with only a minimum of engineering and development to meet specific requirements. A unique switching action provides positive "make or break" action of the electrical contacts at the "G" sensing regardless of environmental conditions.

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Half-mule, half-bird The U.S. Army's Sergeant, now in production, is artillery, and it can traverse terrain where caissons used to go rolling along. And for long, fast hops, the Sergeant can readily be airlifted. The prime contractor, Sperry Utah, wisely selected new, light gages of USS "T-1" Constructional Alloy Steel with 100,000 psi yield strength for the ground support special purpose equipment. USS "T-1" Constructional Alloy Steel is three times stronger than structural carbon steel, thus fabricated components can be made thinner and lighter with no sacrifice in strength. The entire launcher is air-transportable because it weighs only 16,000 pounds—7,000 pounds less than if built with structural

carbon steel. When your missile support system goes on the drawing board, you can obtain applications and development assistance by consulting the one producer of all basic materials for support hardware and facilities. Whether it's carbon steel or special constructional alloy steels, electrical cable or wire rope... consult



"Steel America's strength too."



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Wide use of USS "T-1" steel makes the projectile-launcher launcher 7,000 pounds lighter and considerably air-transportable.



These components of missile systems combine light gage 3 steel and "T-1" steel transfer force to the "T-1" steel for maximum strength and minimum weight.



Air launcher utilizes USS "T-1" steel tubing frame the base ring of the launching superstructure.

All major structural components were designed at an allowable working stress of 65,700 psi.

USS "T-1" steel outgages legs making the unit so firing position. Also made of "T-1" steel was the U. S. Army's 400-ton, top and gun barrel members and back bars.



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...required Motorola systems ingenuity

NAVIGATION with "needle's eye" precision is achieved by Motorola RDM Synchronous combinations of Radio, Doppler, and Inertial sensory data into one integrated system exceed the sum of the capabilities of each. Ranging hundreds of miles from their ground-anchored references, these R+D, R+I and R+D+I combinations provide targeting accuracy...maneuverability to interference...resistance to detection. Unique combinations of these techniques have been proven in applications requiring real-time,

position-fixing and space vehicle-guidance. These Motorola systems originally were designed for missile guidance and surveillance from navigation—they now provide reliable solutions to a broad range of problems requiring continuous, current, and extremely accurate control data never before attained in a dynamic environment. Sensory synergism is another demonstration of Motorola's systems ingenuity. Classified details of these programs are available to those with an established need to know.

Military Electronics Division



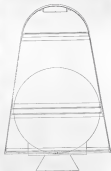
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Line drawing of the 27-in. Trailblazer nose cone shows location of the 15-in. spherical motor. Frames at top (1) define and electronic instrument package is installed in the second half-shell. At left, a General Electric technician inspects the surface of the polished shell.



Trailblazer 2 Series to Study Re-entry Phenomena

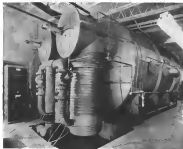
Trailblazer 2 rocket series designed to study re-entry phenomena is under way at Wallops Island, Va., as part of the Program Definite experiment sponsored by the National Aeronautics and Space Administration. Launch Laboratory of the Marshall Space Flight Center of Technology and the Air Force Research Projects Agency. Fourth stage structure was built by General Electric Missile and Space Vehicle Department, which also designed and controlled the motor operation. The stage weighs 45 lb. and is 27 in. long. Weight reduction was obtained by using aluminum and titanium for the motor structure. The four-stage launch vehicle supported and fabricated by Atlas for Research Corp. Space Vehicle Group (ARL-10, p. 102) consists of a Thrust Control Booster stage, which has four White Lightning solid rockets, Guard Control Rocket TX-77, Launch, third-stage Hercules Rocket, Bellco Laboratories 140 Altos and fourth-stage glider, built by NASA's Langley Research Center, called Cygnus. First two stages are designed to lift the vehicle to an altitude of one million feet. The vehicle then nose over, and the last two stages drive the nose cone to a velocity of more than 20,000 ft/sec. Spectrophotograph and various camera obtain velocity data.



Trailblazer's 45 lb. nose cone is serviced with a slotted collar, vent cap. The cone and slotted cap was built by General Electric's Missile and Space Vehicle Department.



ALCOA CAPABILITY AT WORK...
weldable cryogenic aluminum alloy
that's stronger, thriftier than steel



Orbiting Observatory Test Chamber Built

Orbiting observatory being developed by Ball Brothers Research Corp., Boulder, Colo., for the National Aeronautics and Space Administration, will be tested in this 18-ft-dia 15-ft long space simulator. The chamber, built by High Vacuum Equipment Corp., Waukegan, Minn., can be evacuated to 2 x 10⁻⁶ mm without cryogenic pumping. Sealed-off tubes between 200 and 400 in. can be achieved.

Space Laboratory to Test Re-entry

Standard re-entry conditions for a wide variety of space flight probes will be incorporated in a new space vehicle research laboratory now under construction at Aero Corp.'s Research and Development Division, Willow Run, Mich.

The 70,000-sq ft structure will be completed next spring at an estimated cost of \$1 million.

It will be combined with an existing building that previously housed the division's high-temperature, high velocity research facilities.

Laboratory Equipment

The new laboratory will contain the following equipment:

- 10 megawatt arc furnace for high temperature materials research, simulating the cathodes of SCRM re-entry vehicle and related vehicles.
- Shock barrel with 12-ft dia working section. Aero says this facility is twice the size of any similar existing unit and will be able to accommodate nearly full scale SCRM nose cones at pressures of equivalent size. Using 6-in dia shock tube sections stressed to 60,000 psi, the new shock barrel will be capable of velocities of up to Mach 30 and will provide 45 channels of data.

• 6.5-in dia shock tube, for study of the reductive heat transfer loads on re-entering space vehicles. One of the facilities created during force this facility will simulate cathodes space fluxes to 16,000 lbs.

• Magneto-hydrodynamic acceleration shock tube to accelerate sound waves up to 80,000 lbs. Aero says this velocity is comparable to that of a vehicle re-entering from a Mars or Venus probe.

• Micro-leakage shock barrel to study surface interactions of re-entering gas jets with space vehicles at extreme altitudes.

The new building also will house some test equipment already in operation at Aero, including an electron shock re-entry simulator (DSLRN) a 2 megawatt arc furnace capable of Mach 2.5 gas flows with densities of up to 10 mm, and a 10 megawatt arc barrel producing velocities of Mach 5 in a 1-ft dia working section.

Aero says that a 15,000 cu ft capacity central vacuum pumping system will allow almost continuous operation of the large arc barrel and will accommodate data planned future installation of an ultra-high vacuum laboratory, a cryogenic laboratory, a cryogenic low density wind tunnel and a space chamber.



**WELDABLE
 CRYOGENIC
 ALUMINUM ALLOY
 THAT'S STRONGER,
 THRIFTIER
 THAN STEEL**

At -423°F (boiling point of liquid hydrogen), Alcoa® Aluminum Alloy 2219 has ultimate tensile strength of 98,000 psi. Even at elevated temperatures, 2219 alloy's mechanical properties are superior to those of any other commercially available aluminum alloy.

Alloy 2219 has other valuable attributes. For one, it costs about one quarter as much as stainless steels. For another, it's easy to form and is as weldable as aluminum alloy 6061. Also, it is compatible with presently used tools and welders and has good ballistic characteristics.

ALL ABOUT CRYOGENICS — Alcoa Research and Development Laboratories possess considerable information on the high- and low-temperature properties of aluminum alloys. If alloy selection or the fabrication of cryogenic aluminum presents difficulties get in touch with Alcoa. Odds are overwhelming that one of the minds of the men who start these laboratories—or from the volumes of aluminum data at their disposal—there will come the answer.

Write: Aluminum Company of America, 1870 Z Alcoa Building, Pittsburgh 19, Pa.





9 December 1961

A prototype of a huge booster-size, segmented, solid propellant rocket motor was successfully test fired by the U.S. Air Force. The test was conducted for the Air Force by United Technology Corporation at the firm's Development Center near Morgan Hill, California. The giant rocket motor, which was designed and built by UTC, produced nearly a half million pounds of thrust.



United Technology Corporation

P.O. Box 358 Sunnyvale, California

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WHERE IDEAS
UNLOCK
THE FUTURE



PERFORMANCE CHARACTERISTICS

RACON	SPECIFIED	ACHIEVED
1 x 10 ⁻¹⁰ Torr Hg	4 hours	3 hour 32 minutes
3 x 10 ⁻¹⁰ Torr Hg	8 hours	3 hours 32 minutes
5 x 10 ⁻¹⁰ Torr Hg	20 hours	4 hours 27 minutes
1 x 10 ⁻¹⁰ Torr Hg	60 hours	7 hours 32 minutes
5 x 10 ⁻¹⁰ Torr Hg	keeps test	11 hours

COMPLETED AHEAD OF SCHEDULE, the Bendix 30"x27" satellite test chamber is 100 percent vacuum and graduated every 0.00001 Torr. This high vacuum chamber is the heart of the new Bendix Space Laboratories for day-to-day fabrication and test of complete satellites and spacecraft systems.

SPACE ENGINEERS experienced in integration, assembly and testing of satellites will find new careers at the Bendix Space Laboratories. Specialists are needed for thermal-vacuum, vibration, structures, dynamics, radio and noise interference, fluids and mechanics, instrumentation, circuit design, and field test. Write or call Personnel Director, Bendix Systems Division, Ann Arbor, Michigan—an equal opportunity employer.

Bendix Systems Division



VTOL Fighter Concept Based on F-104

Aviation Week artist's conception shows a Lockheed Aircraft Corp. design which may be entered in the North Atlantic Treaty Organization VTOL fighter competition (AW Week 27, p. 28). Arrow, Israeli air force fighter, would have 16 vertical-lift turbojets in its wingtip pods (AW Sept. 26, 1966, p. 23). Left engine would be Rolls-Royce RB 162 (5,000 lb thrust).

Park, Pa.—449,534 for chemical properties of solid carbon.

Washington State University, Pullman, Wash.—448,003 for determination of soil water content with radio.

McDermott Laboratory, Montreal, Canada—447,710 for synthesis of polymer chains deposited on surface with fluorescent energy.

Western Research Laboratory, Cleveland, Ohio—446,678 for vibrational spectroscopy.

University of Wisconsin, Milwaukee, Wis.—446,494 for study of interparticle contact problems.

University of Wisconsin, Newark, Del.—446,144 for study of changes in interparticle contact problems.

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University of New Hampshire—445,991 for investigation of combustion reactions in gaseous phase and under conditions of high pressure and high temperatures.

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Wind Tunnel Tests Set for Flex Wing

Boeing Aerospace's Flex Wing test vehicle has completed the first two phases of flight testing for the Army Transportation Research Command. Aircraft with engine added to second design—photographed here making test flight over Rogers Field, near San Diego. Vehicle was built indoors, and ground test and instrument flight tests will be conducted by NASA pilots, in an Army-funded program at Langley Field, Va.



THERE'S NO SUBSTITUTE FOR VISUAL INSPECTION—

EVEN ON TURBINE ENGINES

Detailed, exacting visual inspection of Dart flame tubes is used to find cracked cooling rings, loose rivets, and other discrepancies. The inspection is very precise — and very honest, for the flame tube is as vital to turbine engine life as cylinder condition is to piston engines.

Like cylinders, flame tubes are normally good for more than one operating cycle. If they are defective, they are repaired in the Airwork shops, using modern methods for handling high temperature metals.

If necessary, the flame tube is sectioned on a lathe, and a new center section added.

Thus the tube is rewelded under a blanket of argon gas to prevent oxidation of the sophisticated metal at high temperatures.

The volume of Dart engines handled by the Airwork shops, justifies the best available test and re-work equipment. But, in many cases, the best test equipment available is still the honest craftsmanship of well qualified inspectors working for a company with a long tradition of quality. We offer you this at Airwork . . . and back it with the trouble-free experience of our many turbine and piston engine customers. Write for our new brochure, "Essential Aviation Services".



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PRODUCTION BRIEFING

Learning Division of Aero Corp. is awarded its largest single engine production order thus far. USAF-521-466,117 for an individual number of T55-L-9 turbines for Bell 105-10 helicopters. Orders extend T55 production through October 1965. The 490-hp engine is rated at 1,100 shp.

Cleveland Pneumatic Tooling, Inc., of Cleveland, Ohio, will provide 35 landing gear sets for Santa Ana's new Aerojet Corp.'s SAAC-35, new transport executive aircraft, which will go into production soon in Switzerland.

Cater Trak Corp., Calypso, Va., has secured a \$107,000 contract from Port of New York Authority for 16 jet aircraft scheduling units, each with 16,800 gal. capacity, for use at New York airports.

Black Instrument Corp. of College Point, N. Y., has secured contracts totaling \$1 million for continued engineering and production of housing assemblies for Aero Black models.

Varian Associates, of Palo Alto, Calif., will build a radiographic linear accelerator to be used by the Air Force for external inspection of Minuteman and other solid-fueled rockets. The 36-million electron volt X-ray device, scheduled for delivery in mid-1962, will be installed at HAF AFB, Calif., as part of a \$2.6-million Minuteman depot facility now under construction. The machine is expected to reduce Minuteman inspection time from 150 hr to 15 hr.

Lenz, Inc.'s Instrument Division, Grand Rapids, Mich., has secured a \$2-million USAF contract to provide ground and associated equipment for use in integrated flight tests aboard F-105 aircraft.

North American Aviation, Inc.'s Rockledge Division will produce 16 each of (in October 1 and 1-50 solid propellant) sounding rocket packages on firm for evaluation by Navy's BuOrd. Aerojet 1 is designed to propel a 6-lb payload to 218,000 ft; Aerojet 1-50 is planned to push a 6-lb payload to 90,000 ft.

Shielding, Inc., of Roseton, N. J., will contract at \$100,000 to manufacture, control and environment facility for General Electric's Space Technology Center at Valley Forge, Pa., under a \$120,000 contract. The complex, due for completion in mid-January 1962, will consist of the means arranged in satellite location around a central clean room.



PINPOINT ACCURACY FOR NASA'S SATURN

... by inertial guidance systems tested on

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Precise directional accuracy of missile or space vehicles such as the SATURN depends on the gyros . . . which must in turn be precision-engineered.

Right now, Dunn Air Bearing Test Turntables are the only tables available capable of quick, reliable and accurate evaluation of the new generation of ultra-accurate inertial gyros.

Dunn T918 Turntable will be used to test the guidance system of the SATURN. Largest air bearing test turntable ever built, the T918 handles loads in excess of 500 lbs./hr.

Dunn Air Bearings are an advanced concept design with many varied applications in the aerospace field. We'd like to discuss your aerospace hardware needs . . . phone us at Cambridge direct 491-3300.



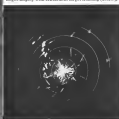
500 lbs. . . tests gyros with drift rates of the order of 0.001°/hr.

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Upgraded photon shows conventional radar scope with single target display (above) and Raytheon helmet display with continuous target tracking (below)



FAA orders new Raytheon bright display to further improve air traffic control

Raytheon's Radar Bright Display System, soon to be operational after three years of development, will mean safer transport for the dying public and greater traffic-handling capacity with existing control facilities. Features include —

SCAN CONVERTED DISPLAY

- ☐ Clearly visible under normal room lighting
- ☐ Target movements self-plotted in true position on map coordinates
- ☐ Adjustable memory, able to retain target signals for minutes
- ☐ Multiple location monitoring displays readily available
- ☐ TV-transmittable picture
- ☐ Instant image erase and rewrite within 2 seconds

POSITIVE AIRCRAFT IDENTIFICATION

- ☐
- Sharp, bright flight tracks, displayed in real time

- ☐ Adaptable for identification symbols that lock-on and move with target
- ☐ Unmistakable hand-off environments

RELIABLE PERFORMANCE

- ☐ Transistorized circuitry
- ☐ Light, compact, sturdy construction
- ☐ Low heat generation
- ☐ Simplified servicing

The Federal Aviation Agency has ordered 51 RBDS-5 equipments for control centers from Hawaii to the East Coast. Their advantages are available for radar, sonar, computer output and other display applications, to meet other Military specifications or the most exacting commercial requirements. For full technical details on Raytheon Seas Conversion Bright Display Systems, write: Raytheon Company, Dept. 72, Lexington 73, Massachusetts. Attention: M. B. Carver.

RAYTHEON COMPANY

EQUIPMENT DIVISION

[illegible]

Kwaialein Nike Zeus Radar Extension Planned

Arbit's version showing *Naja Zinn* inside in entirety of side type. Launch cell indicates deployment streamer for the anti-ECM on Krasnaya's 5th Hg. high. MR Olympus. Deflectors at the bottom of the missile launch cell deflect the exhaust into an adjacent duct and up to the nozzles. Four launch rails are deployed in the complex and accommodate a five-degree cant to the north so that the missile or its bay doors will not fall back onto the launch area of a failure occurs immediately after liftoff.





genus: homo • species: sapiens
discipline: factors engineering

At the six major RCA Defense Electronic Products facilities, teams of psychologists and design engineers are deeply involved in the highly specialized, incredibly complex study of human factors engineering—man/machine interfaces, auto-educational methods, decision processes, read-in/read-out optimization techniques, sensory perception, the entire spectrum of psychological-physiological-physical disciplines.

Whether your requirements involve human factors study of command and control functions for defense networks, or projected life support systems for space exploration, a total RCA capability stands ready to assist you . . . from feasibility study to project completion. Write: Defense Electronic Products, Radio Corporation of America, Camden, N. J.



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the Air Force
Automatic-Tracking
Antenna System!



The powerful TLM-11 telemetry antenna now in service at the Air Force Missile Center, Cape Canaveral, Fla., is used for the automatic tracking of missiles and earth satellites. This huge "mechanical ear," specifically designed by Rockwell, Inc., Melbourne, Fla., has an effective data reception range of over 1000 miles.

One of the key parts of this highly sensitive device is the 36", 50-ohm, aluminum sheathed Styroflex[®] coaxial cable that links the 60-foot parabolic reflector to the receiver. The task of carrying radio-to-earth signals from the antenna to the control building demands a low-loss, high frequency cable with a high signal-to-noise ratio.

The remarkable characteristics of Styroflex[®] cable not only meet these rigid specifications but also have extra operational advantages, including long operating life under severe conditions and stable electrical properties during wide temperature variations.

Styroflex[®] coaxial cable has earned an outstanding record for these qualities in a variety of instrument, mass communication and telemetry applications. Perhaps this cable can solve your particular high frequency cable problem. We invite your inquiry.

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AVIONICS

Display Consolidates C-130 Engine Data

By George Watson

Tenchesco, N. J.—Simplified cockpit display system which summarizes engine performance, using digital techniques, has been developed by Eclipse-Pratt Division of Bendix Corp. for the Lockheed C-130 military transport. The system presents critical parameters of the transport's four turbo-prop engines in 12 vertical scale instruments, replacing 35 dial-type instruments in the present C-130 cockpit.

The system provides the flight crew with the following information:

- Torque being developed by each engine, both as a vertical scale indication and as a direct numerical readout
- Eight other parameters (fuel flow, oil pressure, oil temperature, coolant flow, oil quantity, oil pressure and gear oil pressure) on a wrist

case base. Of the four values of a particular parameter available at any one instant, the system displays the value representing the worst engine performance.

- Acceptable operating limits defined by white segments
- Malfunction indication, identifying the engine and parameter for which an acceptable operating limit has been exceeded
- Optimum operating value or range of values considered ideal for the prevailing flight conditions or throttle setting

Designed for Quick Scan

By presenting information in conventional graphic form, the system allows the flight crew to check for uniformity of torque, optimum performance, and malfunctions by quickly scanning the engine instrument panel. Descriptive data can easily be read from the scales

The magnitude of a parameter is indicated by the height of the white segments on a black-and-white tape. Acceptable operating limits are shown by red striped flags on bars. Optimum operating values are shown by green values, optimum ranges by green bars.

Electroluminescent Lighting

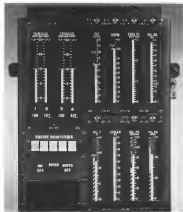
An unusual feature of the system is electroluminescent illumination for night operation. A white electroluminescent screen is located behind the scale of each instrument. Light from this panel passes through the translucent scale graduations and numerals, indicator tape, and acceptable operation and optimum operation indicators. The acceptable operating limit flags, which have several positions, have separate electroluminescent devices. The white, green, and red color code is the same as the daylight requirement.

According to John Sabary, assistant senior engineer at Eclipse-Pratt, the development of electroluminescent lighting having the required color, energy-saving, extremely long life, met a significant portion of the prime development program. Life expectancy of the electroluminescent panels is 2,500 hr, Sabary estimated.

System Operation

Basically, the system operates in full loop:

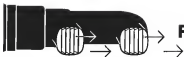
- Signals from nine sensors in each engine (16 signals in all) are fed to the engine input control which automatically selects each of the signals as the input to the computer.
- Analog signal is converted to digital form. This is the sensor signal, a voltage proportional to the parameter. The sensed parameter is converted to binary-coded pulses representing the magnitude of the parameter. The information then is stored in a temporary memory.
- Information on acceptable (safe) operating limits is fed into the computer memory from a permanent storage memory.
- Parameter is compared with acceptable operating limits. If the parameter is out of limits, a panel light over the appropriate instrument notifies the flight crew of the malfunctioning engine.
- Parameter is compared with the same parameter for another engine, and the worst-case parameter stored. The procedure is repeated, comparing the same parameter for the remaining two engines, and the poorer value of the two stored. Finally, the two stored values



PHILIPSON DATA display panel shows magnitude of parameters (white bars), optimum operating range in green, and safe operating limits (striped flags and bars)

BES

AERO POWER

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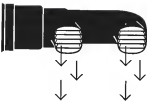
Because Bristol Siddeley lift/thrust turbofans enable the total thrust to be used for lift and propulsion, they provide the optimum power unit for all V/STOL applications. They represent the only practical solution for a single-engine aircraft, with the advantages attendant on extreme simplicity.

Used with separate lifting engines, they present a simpler and more economical solution than can be achieved with a combination of separate lifting and propulsion engines.

SINGLE-ENGINE INSTALLATION

Simplicity resulting from —

- * The resultant thrust and intake drag passing through the centre of gravity



- * Maintenance and spare requirements being confined to one engine
- * Availability of large power reserves for acceleration and manoeuvre

MULTI-ENGINE INSTALLATION

Simplicity resulting from —

- * Requirement for fewer specialised lift engines, as the total propulsive power is also available for take-off.

SUPERSONIC FLIGHT

In Bristol Siddeley lift/thrust turbofans fuel can be burned in the by-pass ducting or plasma chamber to give a thrust boost for take-off and supersonic flight. This plasma chamber burning permits —

- * A large thrust boost for supersonic speeds with only a modest increase in specific fuel consumption
- * Engine performance matched to aircraft cruise requirements
- * Greater thrust for transient acceleration
- * Greater radius of operation

These thrust boost advantages are achieved more economically by plasma chamber burning than by reheat in the hot exhaust gases.

The development of Bristol Siddeley lift/thrust engines is supported by the US Government through the Mutual Weapons Development Programme.

BRISTOL SIDDELEY ENGINES LIMITED

For further information, please write to: Bristol Aero Industries Limited, 10210 P, 112 Boulevard, Montreal North, PQ, Canada.

are employed and the worst case assumed. A transfer mechanism connects the sensor producing the value to the display instrument.

Optimum operation data is derived from two operations. Optimum engine speed (one each of spec 1) depends on a single variable—throttle position—and is stored in the slide-switch memory and for storage of acceptable operating limits. Optimum torque and torque after temperature depend on several variables, and are stored in a specially developed optical memory. This data after digital read-out conversion, is displayed on the instruments.

Input Sequences

The sensor input sequence is clocked by the aircraft's 400 cps electrical power frequency. The input sequence defines the parameter, then switches the four values of that parameter into the computer. This input control allows four cycles for the measurement of each input. Analog-to-digital conversion begins at the start of the third cycle to prevent settling of switching transients. Preceding of the digital signal begins at the start of the fourth cycle. Total measurement time is 10 milliseconds, with 2.5 milliseconds allowed for actual computer operations.

The flight crew can override the input control by depressing one of four

engine monitoring buttons on the instrument panel. This bypasses the automatic sequencing sequence, and connects the sensors of the engine selected directly to the instruments. The other computer functions—self-diagnostics, acceptable operation and optimum operation—also bypassed—continue to operate.

The optical memory used for storage of variable flight data dissolves the need to compare optimum performance from flight charts. Optical storage with square wave selection because this approach offers greater responsiveness, and has non-destructive, high speed (femtosecond) readout. In Sullivan's opinion, the 256-position optical memory is smaller by a factor of 10 than an equivalent capacity memory using more conventional techniques. The heart of the memory is an opaque glass disk containing data in the form of short transparent lines or concentric rings. The disk, driven by a high-speed synchronous motor, rotates past extreme lenses of light (one for each sensor) ring on one side, and exposing photodiodes on the other side. The resulting pulses of light are converted to electrical pulses by the photo-diodes.

The disk contains a start track, a clock track and several function tracks. The start track (the instrument) has only one line, which provides a re-

ference pulse to signify the start of a refresh cycle. The clock track (the instrument) consists of uniformly spaced rectangles which furnish timing pulses for voltage and associated logic operations.

The function tracks contain irregularly-spaced lines representing torque as a function of altitude, dynamic pressure, fuel flow, and turbine inlet temperature, and turbine inlet temperature as a function of altitude, speed, and dynamic pressure. To determine optimum levels of torque and turbine inlet temperature, the actual values of the variables is supplied to the optical memory. This memory notes the shape and intercept of the function at the next higher increment of the variable, and interpolates to find the function at the actual value of the variable. This value, after digital-to-analog conversion is displayed on the instrument panel (as an index) in the case of torque, as a series of rings in the case of turbine inlet temperature.

Lost Panel Space

In addition to simplifying propels in data display, the Eclipse Panel system requires less panel space than the present multi-track display. The new panel is approximately 80 in wide and 15 in high—5 in shorter than the dual indicator panel. The remaining 10 in 5 in area is expected to be used for sensor systems. However, size and weight of the overall system have actually been increased. Weight is 50 lb, divided about equally between computer and indicator panel.



Digital Computer

Nucleon digital computer built by the Temple Corp., measures only 3 x 6 x 13 in., weighs 12 lb., can perform 10,000 mathematical operations per second. Computer called Micro-Math, and Digital Differential Analyzer Machine (NADDA) has about size of 1 ft. Nucleon's MADDA delivers computer density of 60,000 per cubic foot using zero internal solid-state components mounted on triangular shaped or flat boards with chips (AW May 25, 1966 p. 67). Chips fit snugly between flat or wire-wound heat exchangers.

Only Ampex AR-300/FR-700 systems make all these wideband recording techniques practical and routine

It takes 4 sec response to fully encompasses all the above capabilities. Increasing tape speed just twice before would demand 1,500 cps and record only 3 minutes using massive 79" reels. But Ampex puts a full hour on standard 10 1/2" reels by recording the recording heads at 17,000 rpm. Instantly across slow moving tape (170 in) and 25 in) to get the signal reliably hard-to-type speed for 4 in. In so doing, the AR-300 and FR-700 treaders borrow from Ampex's microcassette® Recorders which use a slanted technology to capture TV frequencies.

More bits per hour—another bonus from rotating heads. Rotating heads rotate two disks, rotate freedom from information dropped, and continuous information recorded per reel of tape. With head rotation speed up space, much less of information can be permitted to occupy a greater wave length along the track to state reel dropout. At the same time, rotating heads are ideal for recording very narrow, closely-spaced tracks across the tape. This narrow spacing puts 64 tracks into each inch. Up to 5,000,000 bits of PCM data can be recorded per second or 1 in 10¹⁰ bits on a one-hour reel.

750 similar recorders have within the reliable record—better than 99% reliability from over 750 videotape Recorders in worldwide use in a matter of record. Self-contained replacement necessary are heads and tapes. On a microcycle-fast basis, life compares favorably with lower performance recording methods.

Some significant specifications: One at two tracks available. Tape speed 12 1/2" for single tracks and 1 1/2" for two tracks and 1/2" for four tracks. Models AR-300 module or AR-300 for record only—FR-700 single track laboratory record/playback. Response by FM 10 cps to 4 mc (± 3 db). Tape 1/4 mil Mylar (DuPont V M), 17 mils at 1000 ft. reels. Electrostatic solid state. Environmental (AR-300): 50,000 test altitude, temperature -54°C to +55°C. Tape interchangeability between all AR-300 and FR-700 recorders.



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FILTER CENTER

• Raytheon Fennei Japanese Company
—New company to be set up soon in Tokyo to produce microwave tubes, known as the New Japan Radio Co., will be jointly owned by Raytheon and Japan Radio Co., Ltd., with latter holding controlling interest.

• Call for Reports—Solid State Electronics Laboratory of University of Denver's Research Institute will sponsor 1967 Conference on Thin Films, to be held Aug. 29-31 in Denver. Sessions will cover magnetic films, spin-coated growth, and general film properties. Abstracts of 500 to 600 words should be submitted before Apr. 1 to R. B. Feig, Denver Research Institute, University of Denver, Denver 10, Colo.

• Radiation-Resistant Active Components—New type of active thin film device component which could substitute for and be superior to transistor and electron tubes in its ability to withstand particle and electromagnetic radiation encountered in aerospace environments will be the subject of a research and development study contract to be awarded only next year by Directed Observance Laboratories. The device to be investigated may be based on the tunneling effect or use other radiation-resistant phenomena capable of giving the device the necessary speed, size and lifetime advantages for operation in earth satellites traveling through the Van Allen belts for periods up to five years. The device may be individually packaged or be compatible with thin film circuit concepts in monoliths. Proposals for this contract are emphasizing materials; the other theoretical studies, are due on Jan. 2.

• Signed on the Dotted Line—Major contract awards recently announced by various manufacturers include:
• Raytheon's Waltham Laboratories, Waltham, Mass., \$18,000 award for distributed-parameter weather information data display for Air Force.
• United Aircraft Corporate Systems Center, Windsor Locks, Conn., \$1.6 million Air Force contract for orbital control guidance system development.
• Lear, Inc., Automotive Division, Santa Monica, Calif., \$1.2 million award from Navy for guidance and electrical voice components for Dingo (Dingo) autonomous, helicopter rescue system.
• Westech-Air Arm Division, Baltimore, Md., \$2.2 million Navy contract for repair parts for underwater launch and air energy receiver system for Polaris missile.

NEW AVIONIC PRODUCTS



• Radiation-resistant wirewound resistors, Series N, have demonstrated stability under gamma and neutron irradiation. In separate tests, two resistor (1 kilohm and 100 kilohm) were subjected to a total gamma radiation exposure of 1.9×10^6 rads (10⁵ Ci) at 50°C and to total exposure of 1.45 x 10⁵ rads (10⁴ Ci) at 50°C. In both cases, measurements revealed no difference between initial and postirradiation resistance values. Neutron neutron are also compensated and are available with 100, 1000, and 10,000 ohm values. Tolerances are of 0.005%, stability of 0.01% per year, and temperature coefficient of zero to 2 ppm/°C over a wide temperature range, are available. Manufacturer: Ultracore, Inc., San Mateo, Calif.

• Integrated flight angle sensor and pressure profile sensor, angle of attack, yaw angle and pitch-rate pressures in subsonic and supersonic flight at altitudes to 65,000 ft. Available in gage and vane ranges of 0.5 to 320 deg, with resolution rates to 0.25 deg, the instrument is 17.56 in. long, weighs 0.71 lb (without nuts). Manufacturer: General Controls Corp., 1500 S. Mountain Ave., Denver, Colorado.

• Switch, IFE0000 Series, produces a single square wave pulse action adjustable, as duration from 30 to 180 microseconds and an amplitude from 0 to 55 v. Switch instrument requires no clockwise speed plus input circuit for high speed electronic switching devices. Response time is 100 ns. Manufacturer: Micro Switch Division of Minneapolis Honeywell Regulator Co., Princeton, Ill.

• Millimeter wave chelon rangefinder, for use in the low band (1-10 cm), are available in a variety of complex bands. A typical range angle rangefinder has 3 m. radius and 0.3 deg. loss at 70 km. Manufacturer: TRC, Inc., 9 Union Square, Somerville, Mass.

• Thermoelectric spot cooler, 1 WTC, is a thermoelectric cooling unit which can produce a 0.5°C temperature difference of area with lead is designed for use with instrumented devices and assemblies. The cooler will provide cooling with resolution rates to 1" square inches at 0.5 v and will pump 425 v maximum across area 0.5 g. C temperature difference. Cold sides of thermoelectric extract from component area, heat which is pumped to reject rate and applied to a three fan or other heat sink. Manufacturer: Gen and Thermoelectric Corp., P.O. Box 215, Princeton, N.J.

• Microbar magnetrons, MA210 and MA270 series, designed for pulsed or continuous operation at microwave frequencies within 7.5 to 8.5 cm range and 5.5 to 16 cm range for the two series respectively. Standard tube center frequency tolerance is ±3% and Magnetron output at data rates up to 6.65 mw/1000 watts of thermal power and are compatible for use in applications requiring peak power of 30 to 100 v. At reduced filament power, these tubes can supply 5 to 10 v cw output. Manufacturer: Microwave Associates, Inc., Bedford, Mass.

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or electronic gizmos



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and belts



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we help solve people problems. Like when your project needs lots of people



and there's no place to put them. And you don't want to build a big city



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Geophysics Corp. Expands Space Studies

By George Alexander

Rising growth rates of Geophysics Corp. of America reflects the increasing interest of both the civilian and military space agencies in atmospheric and space research.

Founded three years ago with backing from the Langley & Goddard Institutes, Geophysics Corp. has climbed from sales of \$545,584 in 1959 to \$1,915,159 in 1962, and pending final audit, to about \$3.75 million for that past year. Previous earnings were \$29,411, profits more than doubled in 1960 to \$65,947 and are expected to increase favorably in 1963 with the 1950 flight.

Two recent contract awards to the Bedford Mass. firm completely the scope of its growth work. The first, for about \$108,000, is a year-long study contract from the Advanced Research Projects Agency to estimate the seasonal, diurnal and properties of the exosphere rather than will be supplied by Saturn and Nova launch vehicles at ionosphere altitudes and then provide atmospheric effects on earth-based communications and observations, weather, climate and solar radiation.

The second award, now being negotiated with the National Aeronautics and Space Administration, calls for development and ground testing of a 25-ft dia. wave radii sphere in support of Project Reliant, NASA's second generation passive communications satellite.

Richard D. Coon, Geophysics Corp. president, pointed out the importance of the URPA study by saying that the way which the earth's ionosphere can be used for a communication by the strong glow-visible for hundreds of miles—caused by the release of less than 10 ft of sodium atoms in the ionosphere.

Exhaust Deposit

The company's study, Coon said, will attempt to determine the rate of exhaust matter deposited by various fuel combinations, rate of dispersion and loss caused by winds and diffusion, effects of solar radiation on the exosphere and of the matter on solar radiation—such as reflection or absorption, interaction of the matter with the magnetic field in the ionosphere, extent to which the matter might cause scattering of sunlight or relative resistance and possible

effects on the earth's weather, as suggested by recent theories that solar wind will sweep debris shown in the upper atmosphere.

The firm's research activities—on the one of the company's efforts—fall into four general categories:

- Space sciences, which include studies of the earth's atmosphere and ionosphere, atmosphere of the planets and interstellar of Mars and Venus. Under contract to NASA, Geophysics Corp. is constructing models of the Martian and Venusian atmospheres to assist the civilian space agency in the design of equipment that will have to function in these environments. Also for NASA, the company has launched a series of sounding balloons from Wake Island, Va., in altitude of 60 to 150 mi., releasing sodium clouds to indicate the effects of winds, wind shear and diffusion in these heights.

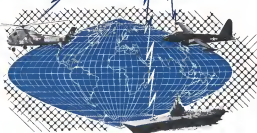
- Nuclear weapons effects and associated detection research, mostly for ARPA. These studies range from short-time phenomena—those effects happening less than 10 sec after a nuclear explosion in the upper atmosphere—to long-term features of the analysis of the nuclear debris. The latter studies, Coon said, are of particular importance because of the increased electron density caused by debris in the upper atmosphere, and consequent disruptive effect on earth-based radar and communication systems. The company also is developing in support of Project Vela, ground-based optical equipment that would detect the scattering of sunlight caused by nuclear debris particles.

- Other study deals with the effect of high-altitude nuclear explosion on ionospheric conditions.

- Ballistic missile defense, which includes studies of the possible effects nuclear missile, explosion and other light sources in the extraterrestrial-altitude bands might have on defense space systems, particularly for those systems that use these frequency bands for the identification, tracking or interception of hostile warheads of spacecraft.

Geophysics Corp. also is performing laboratory experiments of the chemical-physical phenomena caused by chemical reactions occurring among elements in the upper atmosphere and exhaust gases of the type generated by ballistic missiles. The firm also is constructing

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SARAH (Search And Rescue And Homing) systems have operated successfully in every Project Mercury launching and recovery. The mission SARAH transmitter, supplied for Mercury, by Simmonds Precision Products, Inc. is activated automatically during descent, after withdrawing all environmental forces of space flight. SARAH receivers, installed on aircraft, ships and stations throughout the free world, receive the beacon signals and transmit location of the capsule.

SARAH assures quick, safe, dependable recovery of America's astronauts!

The outstanding success of SARAH has focused increased attention on its proven capabilities in personnel location and recovery applications, for which it was originally designed. Civilian agencies and the military are increasingly using SARAH for the most effective personnel rescue operations.

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ASTRONOMICAL BORE, constructed by Geophysics Corp. scientists, is used to indicate data gathered from tracking various concepts of sodium cloud motion in the ionosphere.

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Hughes systems, developed to meet the most advanced fighter mission problems, have joined airborne systems development. They have flown with the F-86, the F-4B, the F-102, the F-106, and other U.S.-Air Force, U.S. Navy and Canadian aircraft.

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of steel speeds and at high altitudes have been solved. New techniques are being applied which provide for more efficient cooling of the thousands of electronic parts and assemblies, promising greater reliability.

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These kinds of advancements are the "meat" at Hughes. For they are the result of over 16 years of prior experience in the design and building of airborne systems. The new Hughes Tactical Attack System has grown out of a special, company-funded program which has been active for three years.

An important part of Hughes airborne systems capability is the company's background in field service and support functions. This work, involving seven major systems, helped in the development of the unique self-test features incorporated in the new Hughes Tactical Attack System.

Better today, better tomorrow. The Hughes Tactical Attack System, like other major new defense systems, is worth more simply because it does more more—its actual hardware capability and its skills and facilities that back its success.

- (1) Hughes Tactical Attack System has all the features and technical advancements meeting its mission.
- (2) Hughes has one of the few World's most efficient electronic manufacturing capabilities.
- (3) Hughes employs more in experience gained in the design of systems far more complex than any other firm.
- (4) Hughes Field Engineers have worked with more than 40,000 airborne control systems.
- (5) The Hughes system will not become obsolete before it flies. Rather, it is presently designed to keep step with improved aircraft performance and new demanding mission requirements.

Creating a new world with electronics

HUGHES

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SODIUM VAPOR CLOUD, released in two sections at altitudes of 130 and 225 miles, the 144 ft. pointed at a four-story. Aps launch vehicle from a composite test. Clouds appeared scattered the cloud's movement to measure velocity, temperature and duration of atmospheric study at high altitudes.

hypothetical models of the physical properties of thick water and the trade of gases and solid particles cannot be made. When pointed flight. The dimensions of a test, before made, worked among about a still smaller company project and Coors said that the Geophysical Corp. proposal to conduct experimental work on this class technique is being actively considered in the Defense Department.

• **Infantile vehicles** for use both in the upper atmosphere and space. Coors said that the company is building "actual" structures and structures in space in geophysical work and as vehicles which can be used to study the density and winds in the atmosphere ranging from 20 to 60 mi. "The NASA contract for an inflatable rigid pressure container vessels will allow the firm to investigate its approach to the problem of a balloon that is sufficiently rigid to maintain its shape for optimum signal reflection, but will not be weight. Geophysical Corp. plans to start a standard balloon within a year, which will be the cooperative efforts of children with balloons of the balloons, race to other would extend the size much into a sphere, and the balloons then could be inflated or inflated to be pumped by remote drive pistons. Spacing between the mesh will be approximately

3 mm, reflecting microwave signals of 5 cm wavelength.

In other projects, Geophysical Corp. is investigating the possibility of chemical modification of the atmosphere of other planets, so as to make them render to that of the earth and perhaps capable of sustaining life. To provide continuous electrical power for spacecraft during day and night, the company is looking into the feasibility of an atmosphere battery. Admitting that the practicality of the concept remains to be proved, the firm says that as presently a space vehicle should be able to extend plane at two decimeter scale into the ionosphere that exists in the ionosphere, and draw a current of about 2 ampere/cm² at an altitude of approximately 115 mi. Potential would be about 1 volt. Coors and plan would have to be "at least 100,000" in diameter, 100,000 in diameter.

Geophysical Corp., with Milton Greenberg as president, employs about 125 personnel and has four divisions.

- **Physics Research**, which the atmosphere, nuclear detection and ballistics remote detection work is carried on.
- **Daniel W. Moore Co.**, Lincoln, Mass., produces precision measuring instruments, optical comparison photo-reproducers, lens test benches, reference cameras and camera calibration.
- **Women Applications**, Inc., Denver, Colo., reported in April manufacturing high vacuum processing equipment.
- **Vana, Alaska**, Alaska, manufactures 115,000 ballistics and ballistics most of the company's inflatable structures.

Ford Takes Control Of Philco in Merger

Philadelphia—Ford Motor Co. has assumed control of Philco Corp. with the purchase of Philco's assets for approximately \$160 million in Ford stock. The acquisition extends Ford's activities into the household consumer computer and transistor markets and replaces the company's position in the military electronics market.

President of the new Philco Corp. is Charles F. Bell, former director of Ford's business planning office. Bell replaces James M. Skinner Jr., who stepped down from the Philco post in March 1967. Bell, director of this new acquisition is composed of assets of Ford management. Elected officials in Philadelphia's former Philco management personnel.

Bell stated that Philco will be equal and as an "independent subsidiary" of Ford. Moore believes behind the acquisition was Philco's potential for expansion and growth. He said Ford is particularly optimistic about prospects for Philco's government and industrial group which has handled many major in-house programs.

Beech Aims at Widening Market Potential

By Ernie J. Bollen

Wichita, Kan.—Rebarnco's in the 1962 line of Beech Aircraft Corp. business airplanes, planned at manufacturing price increases, will be a major factor in the company's marketing program in the year ahead.

Beech estimates that conventional business in 1962 probably will be 15% higher than fiscal 1961 when company revenues reached approximately \$45 million, including spare parts and accessories.

To further broaden its market potential, the company's Wichita-based finance subsidiary has launched the industry-wide floor planning and financing program, providing a substantial discount in the cash costs acquired by sales outlets at the time of purchase of demonstrator units. Cash interest rates have been cut in half as company executives noted.

Beech also is pushing its program of adding retail outlets to the current six-month lease of about 115. A recent, completed survey indicates that there is a potential for 158 retail outlets in the U.S. capable of handling single-engine aircraft sales profitably.

Although a key feature of the meeting here of a group of Beech distributors was introduction of the company's new 512 900-hp four-place Manufacturer (AWD Dec. 4 p. 94) it was emphasized

that this airplane will not be ready for delivery until early 1963, and therefore would have little or no effect upon fiscal 1962 sales volume. Major attention was given the company's standard two-place model, introduction of the new Model P15 Bonanza and A15 Baron light twin in advance of introducing these airplanes into the field for detailed demonstration at retail sales outlets across the country.

New points of spending cut introduction of new models and providing a simultaneous upgrading of its units, line was emphasized. In the company, this was (AWD Oct. 25 p. 182).

Regional Introduction

In the field regional introduction of the Bonanza and Baron this month follows a similar program started with the 1962 Quaker Air and Debonair in October. New Bonanza and Baron will be purchased at distributor facilities in an eight- to ten-hour turn starting Dec. 11 and ending Dec. 18. Vice President-Marketing William L. Horvath will head the faction, personally covering the eastern portion of the country, and Vice President-Domestic Sales Lesley L. Green will be in charge of the western team. Customer prospects for the airplanes also will be invited to observe the Bonanza and Baron during their visits to the distributors.

• **P15 Bonanza** features interior styling with effort to improve passenger comfort centered around completely new, comfortable passenger seats having infinitely-variable position back. Its streamlined panel also has been revised to incorporate 17 mounting of the flight group on a separate, removable shock-mounted panel. Radio equipment positioned on the right is shifted toward the pilot for correct handling. Engine group now incorporates a combined manifold and fuel pressure gauge to simplify interpretation. This is an improvement over 1961 version's model (see box, p. 97).

• **A15 Baron**, which has been one of the major innovations in the line since its introduction last year—production line sales have adjusted upward this time in 1962—the unit is being offered with an optional version. New four-place unit can be folded and stored when not being used. Other Baron improvements include capability of extending landing gear and depressing flaps 15 deg. at 175 mph indicated, an increase of 15 mph for the configuration, which is aimed at easing traffic pattern landing. Propeller tips are mounted to reduce noise level.

Market Opportunities

Market opportunities for the company's 1962 line, detailed by Green, provided a foundation in category, in which Beech line increased sales will be accepted.

• **Bonanza and Debonair** are listed to a total domestic market for this class airplane averaging more than \$11 million per year, in comparison with Cessna's 210 and Piper's Comanche 250. According to Green, Beech Aircraft's profit coverage has been about 42% of the volume and he expects that the company should participate in the capture of at least 50% of this business. Beech marketing statistics, based on 1960 data, show that 50% (700 units) of sales of Bonanza were made to previous owners of this airplane, 20% (50 units) were sold to owners of competitive makes and 30% (110 units) were sold by the company to previous non-owners of aircraft.

• **Twin Air and Baron** light-twin (two airplanes operate in a market totaling \$15 million annually and include as competitors, the Cessna 310 and Stearlight, Piper Apache and Aztec, Green noted. In this market, Beech airplanes have been an average of 27.1% over the last two years, he said.

• **Two-Bonanza** medium twin, which



WIND TUNNEL TESTS recently completed on a model of the proposed Beech Aircraft Corp. two-engine-powered customer transport confirm expected engineering of customers according to Beech Executive Vice President Frank E. Nichols (AWD Dec. 18 p. 26). Details of the airplane still are being withheld pending selection of data as requested during the model testing program at the University of Washington. The aircraft will have a gross weight of about 12,500 lb., and cruise at more than 300 mph at 15,000 ft., according to Beech.



DECISION to use the two-engine passenger transport that the year yet has been based on an evaluation of all types of turbine engines conducted by Beech. The survey indicated the propeller turbine combination would permit building in excess of the unit required by Beech for approximately 50% less than cost of the present type now available for delivery. Beech estimates that its two-engine configuration will be brought out at a base price of \$400,000 and include optional equipment with all the features including cabin for about \$100,000. Somewhat close to the Beech project is noted that the 1,500-hp French Indenor diesel 4 was the leading propeller engine at present.



BARON INSTRUMENT LAYOUT has radio gear (right) mounted in degrees toward pilot to facilitate handling. The glow shield atop the panel is designed to improve visibility. Panel has fuel tank selector system incorporating easy-to-follow diagram. Spray or Ditcher auto-pilot are optional equipment in the Beech Baron.





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608 prospects for single-engine, equipment, 100,000 for light twin and 60,000 for medium twin class.

This data was developed from a detailed study of the total number of U.S. companies. Those firms which had no need for airplanes or ability to buy them were eliminated. Buying patterns of airplane men were then studied as well as marketing patterns of business travelers and the total degree of airplane acceptance all over the country, so that these factors could be applied against the potential that was revealed from the overall total to test validity of final prospect breakdown.

Beech export operations last year totaled nearly 512 million—a gain of 51.5% over the foreign sales team's 1963 effort, which in turn had represented a 100% increase over 1959. Bechtel's foreign sales by Export Sales Vice President Michael Neuberger's overseas distributor-dealer organizations achieved more than 14% of Beech America's total volume last year, in comparison with 5% in 1960.

Neuberger admitted that the European Common Market can be expected to have a highly significant influence on foreign sales of business airplanes should become in time it will comprise a group that will be equal in economic strength to the United States and surpass the Soviet bloc and he expects that the purchasing power the market will approach will cause them to effect import restrictions that may be imposed on American products. Eventually, he noted, the U.S. may, in some form, become associated with the Common Market and other international trade groups.

Beech also reported that the Japanese navy has developed to him three Quon Aqs. Beech contemplates that this purchase will be the first of orders by the Japanese navy for approximately 50 airplanes over the next five years. In line with relations with the U.S. Army is planning to buy 40 military versions of the Quon Aq (L-21P) with production commencing over the next two years. These contracts are expected to hold in price down on future Quon Aqs.

Two-Place Beech

Two-place private plane has been on the brink, in Beech, and this probably will be a revised version of its own last plane, Model 22. Model 22, however, was cancelled at Beech's distributor meeting, it is to be marketed in each fall of 1963 (not early fall of 1962, as previously reported in Aviation Week Dec. 4, p. 94). Two-place version of the Model 22, however, will have a lower powered engine in the 100-hp class, instead of the two-place model's 160-hp Lycoming.

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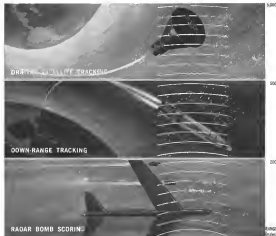
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SAFETY

CAB Investigates Imperial's Maintenance

By David H. Hoffman

Minor Beech-Craft Aeromaster Board investigation of Imperial Airlines has uncovered a history of discrepancies in the aircraft's maintenance, several looping and flight crew coordination problems that may have led to the crash, and Imperial's record of at least one fatal crash, killing 77.

Although CAB investigation was concerned only with the cause of the Nov. 8 tragedy, these questions led Imperial executives to give a detailed description of how at least one major maintenance problem and operator error in aircraft. Lengthy records of the four-day hearing undoubtedly will restore the clear attention of congressional committees planning to investigate the supplemental airline industry's safety practices (AW Nov. 20 p. 37).

The crash, in which 74 Army aviators were killed, led Defense Secretary Robert S. McNamara to order that supplemental airlines carrying military personnel within the United States receive clearance from the Military Air Transport Service (AW Nov. 27, p. 37).

The Lockheed OH-130A transport, operated by Imperial, stalled while attempting an uncheduled landing at Richmond, Va., with its No. 1 and 4 engines feathered and its No. 3 engine losing power. Only the aircraft's pilot, Capt. Ronald Conway and flight engineer, William F. Posthuma, survived.

Public Hearing

Testimony during four days of public hearings, conducted in Richmond and Miami Beach by an eight-man CAB technical panel posed their crucial questions.

• **Why did Imperial's chief flight engineer, John Merfield, declare the Conquest aircraft after one of its fuel boost pumps had been repaired with a brush honed from a used 7914 Mercury automobile generator on the day before the plane's last flight?**

• **Why did the airline elect to operate the Conquest for at least 130 flight hours after purchasing an engine due for overhaul and install it on the aircraft without informing Federal Aviation Agency of the airline's authorized time between overhaul (TBO)?**

• **Why did Imperial fail to designate one of the two qualified captains as head of the search in pilot maintenance?** Conflict arose between the two as the plane stalled Richmond's Red Airport with two dead engines and both pilots gave orders to the flight engineer.

• **Why did the two pilots apparently not realize that two relays, though which fuel and hydraulic pressure could have been obtained from the Conquest's two auxiliary engines, were placed in an open position?**

• **Why were component, engine and airframe issue control records kept by Imperial at least one week behind the day of the accident and why, during the month of October, could no record be found of the fuel taken on by the Imperial fleet?**

Posthuma, on the boost pump repaired with the used auto part was in sharp conflict. CAB and FAA questionnaires agreed that on the first hearing day, Chief Flight Engineer Merfield stated that he had made the part fit the Conquest's No. 3 engine—one of those that failed by cutting it with a hack saw. The next day, Merfield maintained that the hands had been used to secure the aircraft's No. 3 boost pump at Columbus, S. C. Only the No. 3 engine remained in operation throughout the aircraft's final flight.

Whether the No. 3 engine boost pump contained a faulty part was not technically at issue in the hearing. Failure of this pump could not in itself account for the seriousness of loss of fuel pressure in the Conquest's two right-side engines that was reported by Capt. Conway. It could it explain, especially the stability of Flight Engineer Posthuma to return either No. 3 or No. 4 engine after the failure had occurred.

The plane's No. 3 engine, according to Manual Lopez, Imperial's supervisor of maintenance, had been purchased from Takan Airlines when Conquest's No. N2732A was in Great Britain. At the time, the engine had been flown 1,116 hr, was over-hauled, and Takan's authorized overhaul time was about 1,150 hr as fixed by the British Air Registration Board.

Lopez, a former Cuban flight instructor who defected to the U.S. last January, indicated that because Imperial's TBO on the engine was 1,400 hr, continued operation of the powerplant was legal. Lopez said at about 1,300 hr, much prior to the accident.

At the hearing, FAA officials failed to cite any agency rule or policy that would have prohibited the acquisition of a time-overhaul engine from a foreign airline. However, George G. Reed, principal FAA maintenance supervisor, testified that he would not have permitted the transaction if the engine had been operated to its TBO by a U.S. owner, even if

that TBO were lower than Imperial's.

The dual engine failure was experienced by the Conquest's crew when the plane was northwest of Richmond. Turning eastward, Capt. Conway made a decision to land on Red Airport. Runway 15, an 8,000-ft open field located directly into the prevailing wind. Conway's intent was to make a shallow left turn into the field engines and then land gradually with the runway.

Cockpit Discussion

As he approached the field, however, the cockpit, Capt. James A. Gonzalez, attained the landing gear lever, insisted that the landing be made on Runway 02 and took over control of the aircraft, Conway said. Approach to 02 necessitated a sharp turn to the left and a rather steep descent. During the turn, Conway testified, the two pilots realized that they would either overshoot the runway or fall down before the landing gear could touch down. Gonzalez said he decided that instead of a 110 deg. turn to the right to align the aircraft with Runway 15. It was during this time that the third engine began losing power. With gain in altitude, the pilots could not maintain altitude and the aircraft struck the ground about 1.5 mi from Runway 35's threshold.

Conway testified: "It was not until we were just about to impact that Gonzalez said, 'Do you want to fly this thing and I will assume as captain?' We agreed on that." Despite FAA regulations that require an airline to designate the pilot in command at each flight, Imperial's operating policy was to allow qualified captains to exchange duty on any existing mission, Capt. Warren M. Young, Imperial's chief pilot, testified. At a point, he said, when a flight involved several landings, the company could not assume which captain was in command on a given leg.

While the accident was uncovering, even Red Airport, the student flight engineer as board went all over the passenger cabin to open the airstair flap, closed fuel valves, Conway testified. This valve, which is kept closed in normal flight, must be opened if fuel is to be transferred from the left wing tanks to the right wing tanks, or vice versa. By lifting the main arm and removing a cover plate, the valve becomes accessible and can be turned by hand.

Conway testified that Gonzalez, who held an airframe and powerplant maintenance license, refused to the cockpit to get a screw driver. Gonzalez, intensely and legally the co-pilot but also



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a lone check captain for Imperial, or closed the standard flight engineer not to open the cross feed valve. Veterans Canadian pilots at the hearing could not offer an answer for this confusion.

During the Richardson stage of the investigation, CAB officials revealed that main fuel injection nozzles from all four engines found in the Constellation's wreckage contained two types of "foreign material." One type, they said, was black and non-magnetic in character, and the other was reddish brown and magnetic. Last finding of the aircraft took place at Columbia and was accompanied from two tracks operated by Airscale Sales and Service Co.

On the Constellation, another valve permits hydraulic fluid under pressure to cross over from the aircraft's primary system, operated by its No. 1 and No. 2 engine driven pumps, to its secondary system, supplied by No. 3 and No. 4 pumps. Secondary system pressure helps lock the main gear in place during a normal extension cycle and releases the main gear uplocks. When this pressure is not available, the gear may be locked down as about five to six minutes with a manually operated pump handle.

Although Conway testified that he ordered the hydraulic cross over valve opened over Richardson, the valve was moved from the wreckage in a closed position. CAB questions also brought out that the hydraulic head pump in the Constellation's cockpit was being operated just prior to ground impact.

On Imperial's record-keeping practices, Chief Inspector Reid testified that the entire system was "very faulty," and that usually "fell far behind the actual accomplishment of work," so that it was difficult to detect the "actual condition of the carrier" at a given time. Admitting that Imperial met the minimum standards laid down by civil aviation, Reid found particular fault with the manner in which Imperial flight crew attended discrepancy and maintenance reports from the field to the airline's Miami headquarters.

As a result, he said, subsequent flight crews could not adequately report practices aircraft and flight engineer logs. Reid said that he had recommended changes in this procedure early in August and again Imperial until Oct. 1 to comply. Still not satisfied after this deadline had passed, he wrote the company on Oct. 15 advising its officers what FAA would and would not accept in the way of specific reporting procedures, he said.

Superintendent of Maintenance Lopez and two Sen. civil maintenance inspectors, both held airline and postgraduate licenses issued by FAA, in do the airline's flight engineers. But all of Imperial's full-time ground mechanics held only Civilian certificates.



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LETTERS

More on the X-15

1 Congratulations to *Aerospace Week* on two very timely and informative articles on the X-15 in the Nov. 20 issue.

2 I think, however, that further the *Aerospace Week* is going repeating the 100% success of the design team on altitude and the new adaptive light control system installed in the number three X-15. This program to develop this system was initiated in 1958 by the Flight Clinical Laboratory, NASA. The objective of the program was to design and test a system which would be capable of controlling a climb or descent during recovery, and the X-15 was selected as the test vehicle to demonstrate the capabilities of the system. It had been demonstrated that the range of manual position and the rate of change of these parameters in the X-15 was as good as, or greater than, those predicted for other lift-off vehicles.

3 At about this time the design altitude of the X-15 was lowered from 500,000 ft to 250,000 ft, possibly due to flight control limitations of the existing X-15 system. In 1960, the study program on the adaptive system had shown that it would overcome these limitations. Therefore, the program was started which defined recovery design altitude again for the number three X-15 and retooling the system for the first time X-15. If the adaptive flight control system demonstrated in flight the same capability it had shown which operated on the X-15 test flight mission.

4 That this new adaptive system will increase the capability of the X-15 is a fortunate aspect of serendipity. The program objective was to develop a completely automatic system including angle of attack, altitude, and heading load modes with complete stability augmentation with the reliability and full safety capability required for future vehicles. That the system accomplished this is borne out by the fact that since the X-15 program began, no one being applied to future space system of vehicles.

5 Lt. Col. Clarence M. Moseman, Chief, Flight Clinical Laboratory, Wright-Patterson AFB.

First article on the X-15 research program [AW Nov. 20, p. 12, and Nov. 27, p. 37] gives an excellent overview of the significant accomplishments of the program. The editorial, *Deliver to the X-15* [AW Nov. 20, p. 21], gives an excellent overview to many of the men who helped make these accomplishments possible. However, I feel that at least one name should have been mentioned: that of USAF Capt. Fred G. Kriegerle, who was cited to be the primary USAF pilot of the X-15 and who ultimately died in an F-104 accident at Edwards in 1955.

6 Major L. Moseman, Lang Research Corp.

I would like to correct some inaccuracies in what you published in "X-15 Days."

Aerospace Week celebrates the *anniversary of its readers on the same issue as the magazine's editorial anniversary. Address letters to the Editor, Aerospace Week, 120 E. 42nd St., New York 26, N.Y. To receive letters only, \$500 annually and give a generous subscription. It's all for your personal convenience. Letters, but no more, will be published on request.*

from Based in New York [AW Nov. 20, p. 37].

The X-15B engine has to the date been exploded during its testing last in Edwards AFB. The explosion on 4 Jan. 1958 which destroyed X-15B-21 was a result of a double malfunction in the power section of the No. 1 tank. The No. 1 tank exploded, not the engine.

WALTER B. WAGNER
Propulsion Branch Engineering
Pittsburgh Technical AFB, Ohio

Titov Flight

The article on the recent Russian demonstration of Titov's flight [AW Nov. 27, p. 25] states that "a cautious, but additional information on the launch vehicle. This is a surprising statement since the launch itself being the subject of investigation, controversy, and speculation has finally been officially released (and is posted by *Aerospace Week*).

Actually, the figure given falls in more than just the chronic dull. For example, we note that it is given in four significant figures. We would then do that since rocket thrust cannot be increased that accurately. Obviously, it is because this thrust was quoted in metric tons in recent mission and then converted to pounds. The stated value of 1,521,000 lb is equal to 690 metric tons.

The launcher used an engine with a total thrust of 500 metric tons. If we use the figures used in 1944 of 190 metric tons, how it must have been 8.14%. Or if the Russians have dropped their capacity to even launch of course then then, then, most it will be equal thrust and all 8.14%. Of course, we can think of constant thrust in their engines of 120 metric tons plus two of 80 but this assumes that both main engines are fired, instead of one. If we use a single engine of 110 metric tons plus a constant thrust of 10 metric tons, a conclusion would add up to over 500 metric tons.

The previously released total horsepower of the launcher engines of 70 million when loaded with the new figure for thrust as stated as about 100 million, 5,000 ft per sec or a specific impulse of 110 pound thrust per pound. This level is not right up to the assumption that they are using the old launcher propellant, rather than some more exotic combination now by design and design.

The question arises as to whether all engines are used in the lift-off or some kind of partial or limited staging arrangement—on 4 Jan.—or whether the more conventional reaction arrangement—Titov, before etc.—is used.

If the number of engines used in a vehicle is the major determining factor—because of engine cost and reliability—then we can be shown that the larger payload can be loaded by using the specified term but at engine of equal size as a lifted conclusion. This gives the highest gross weight and highest payload. It does not necessarily give better gross weight to payload ratio but fails to propellant as very expensive compared to engine, maintenance, etc. It may be that the Russians are using the design philosophy and that all its engines are used in lift-off.

Using this approach the gross weight could be about one million pounds and the gross weight to payload ratio 300 lb thrust and 51 lb in the Venus probe or last period (14,000 lb). The latter figure gives a better period corresponds to our best performance to date. Any better thrust than that from the full 32 engines, it would mean that they have more efficient design than our own. This seems highly unlikely. It seems much more probable that they have achieved higher period per tonnage simply by using larger size vehicles using the same propellant and the same gross level of design efficiency, as have discussed here.

D. M. COCK
General Electric Co.
Missile and Space Vehicle Dept.
Philadelphia, Pa.

(We've got the total thrust of 6,000 horsepower in the Titov, then, Antares. It's a converted thrust to pounds, rounding off the last three digits. Using 1,500,000 lb, the rounded figure was 1,521,000 lb [p. 25].)

Swiss Pilot Training

Thanks for your excellent article on Swiss pilot training [AW Nov. 20, p. 111]. You correctly pointed out that the 100% incidence is reported by a specific source. It is false on some military base in Switzerland and not necessarily the reason why the man's solution is better at age 20. The source claims that his own testimony to the best of his abilities, he is taking the time to go to the cockpit of the plane, the pilot or instructor's job to do it and however much a soldier out of the man. A large number of accidents are discussed during this one week period of high level training. The body must go to go to France, Flight School at Lacroix.

Swiss pilot training process continues. A further point of interest may be the fact that a Swiss pilot or instructor's obligation to the country does not come when he is in the cockpit, but he is obliged to another country. He is then obliged to pay 24% of his yearly income, called military tax, for a period of eight years. This is the price he pays for his right to fly, while his contract at home is their yearly compensation from duty.

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F. A. BERNARD
Pittsburgh, Wash.
Formerly of DeBenedictis, Switzerland



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